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THE AVOIDANCE OF FIRES

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THE
AVOIDANCE OF FIRES

BY

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AGRICULTURAL COLLEGE

D. C. HEATH & CO., PUBLISHERS
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PREFACE

The conservation of resources is a worthy national ideal, and the reduction of fire waste is an important factor in such conservation. The abolition of poverty is brought one step nearer by the avoidance of the vast loss due to this cause. Public sentiment is becoming a force in dealing with fire prevention: thirty states now have the office of State Fire Marshal and seven states require that the public schools give instruction in the prevention of fires.

It is especially important that interest be aroused and maintained in the avoidance of fire waste. The citizen should become conscious of the elements of danger in the various situations in which fires originate; a more general consciousness of hazards would work great improvement over prevailing conditions. One cannot read the accounts of fires reported in the press, with their associated accidents and fatalities, without feeling strongly the obligation of the public schools to do all within their power to mitigate this record of waste and woe.

The purpose of a textbook on fire prevention should be to create a mental attitude as well as to impart information. The pupil should acquire a genuine

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interest in the avoidance of fire waste and fire dangers. It is hoped that the present volume may serve to create such an interest. The information presented, the exercises, problems, and questions, and the arrangement of subject matter have been governed by the desire to enlist the intelligent and spirited interest of pupils.

The book may be used in a great variety of classes. The lessons may be taken up weekly during the larger part of a year or used daily for a month. Fire prevention may properly be correlated with language, civics, arithmetic, elementary science, or physics; it deserves a place in courses of study intended to prepare the millions of public school pupils for economic and social relationships.

The bibliography appended to the text contains names of publications suitable for reference reading. These and other publications have been freely used in preparing the present manual, oft-repeated cautions necessarily being incorporated in the text. I wish to acknowledge the assistance of Mr. Charles G. Carlson in assembling an amount of material on fire prevention.

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THE AVOIDANCE OF FIRES

I

Why Teach Fire Prevention in School

THERE is much need of instruction in fire prevention, for the annual loss of life and property by fire is very large. And if there is a general need of teaching fire prevention, there is an especial need of teaching it in the schools. The schools exist to make a difference in the lives of people and in the ways of the world. Preventable fires cause great waste, and it is the duty of the schools to do whatever they can to prevent this loss.

Society is sure to reflect what is taught in the schools. Teach children about fire prevention and there will be fewer buildings burned. The service which the school may render in this matter is very great. If pupils all over the country were taught about fire prevention, and practiced what they learned, the saving in the wealth of the nation would go a long way toward supporting public education. The schools may thus render an important economic service.

Children should learn about fire prevention because children often start fires. If this subject were presented in the schools, we may be sure that there would be fewer fires due to the carelessness or ignorance of children. They would feel an interest in avoiding the losses and dangers due to the careless handling of matches and to the building of bonfires. They would come to look upon fire, when not properly controlled, as a source of great danger.

The pupils carry instruction into the home by talking with their parents about what they learn in school. When the family gathers around the table at mealtime, Mary or John may tell what the teacher has said about the preventing of fire waste. This will start a discussion in the family, and Father may remember that he is storing the ashes too near the wood pile, or Mother may recall that some matches were spilled in the attic. Other pupils will talk about this matter in their homes, and soon the whole neighborhood or the school district will begin to take a vital interest in it. Then there will develop a fire-prevention conscience — and such a conscience is a good thing to have.

We can readily see that, if the different schools were to give lessons upon fire prevention, after a while public opinion would become educated, lawmakers would pass necessary laws to reduce fire waste, and the press would caution the public. The person who is careless with fire would come to be regarded as an evil-doer, and the one who is careful would be regarded as a desirable citizen.

The school that teaches its pupils fire prevention will win favor in the community. Nothing commends a school more than the fact that it is teaching subjects of a practical nature. The severest critic of the courses of study would be favorably impressed if his attention were called to the fact that the teachers were showing the children how to prevent fires.

For the Recitation

1. What is waste?
2. Mention several conditions which schools seek to improve.
3. Show how schools improve people.
4. Show how they increase wealth.
5. Explain how the schools through courses of study may contribute to their own support.
6. Why should young people be taught fire prevention?
7. How does instruction in school affect conversation at home?
8. Give an example of this from your experience.
9. How is public opinion formed?
10. Discuss the social effects of being careless with fire.
11. Report a conversation on fire prevention.

II

What Fire Is

Natural Agents

THERE was once a time, many, many years ago, when fire was not in use. The means of making fire and the uses of fire were quite unknown. But even in those early days fire was seen occasionally in nature. Volcanoes threw out hot molten lava, which started fires that often spread for great distances. Lightning, also, was a familiar sight, and forests were occasionally set on fire by it, just as they are today.

But our early ancestors lived without fire of their own making, and a dismal world it must have been. In the modern world fire is the very center of household comfort and pleasure, for by means of it we are warmed and fed; and to watch the glowing coals or the snapping wood in a fireplace is one of the joys of a cloudy afternoon in autumn or of a rainy day in early spring. So pleasant is it to watch a fire on the hearth, that in many of our homes the fireplace has been kept, although present methods of heating make it unnecessary.

Evidences of Very Early Use

Yet it must be understood that fire first came into use a very long time ago. In the caverns of the cave men there have been found burned bones and bits of charcoal which indicate a very early knowledge of fire. But just how long fire has been used, no one can tell. Its first use was an invention of immense importance, but we have no way of knowing the exact time when, in the depths of the past, primitive man first learned to make fire or to keep going a fire that had been lighted by lightning or by lava.

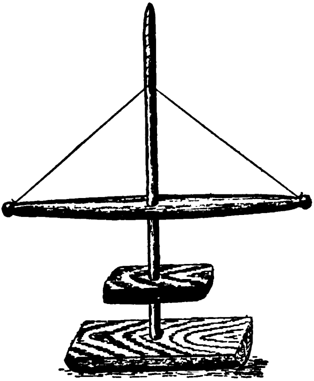
Primitive Man Making Fire by Friction

Doubtless man first learned to use fire through experience with the burnings started by these natural agents. To have accidentally discovered certain uses of fire would have been very natural. A bird or an animal cooked in a forest fire may have been tasted and found especially palatable; and some one may have had enough wit to save coals and keep a fire going.

The rites of early religions suggest the practice of not letting fires go out. In Rome, for instance, it was the duty of the vestal virgins to keep the sacred fires in the temple of Vesta ever burning. If in ancient times there had been an easy way of starting fire, possibly such religious customs would not have grown up.

Primitive Methods of Making Fire

But at last some one discovered a way to start fire. How the discovery came about must be left to the imagination. The producing of heat by friction is a very common occurrence; and if a small degree of heat can be produced by friction, of course a greater degree can be. It is but a step from a knowledge of friction to the application of this knowledge in producing fire by friction.



PRIMITIVE FIRE DRILL

The Polynesians used a pointed stick, which was moved up and down in a groove. The bushmen produced fire by spinning a sharp stick about with the hands, the point of the stick resting in a depression in a piece of wood. With the right kind of wood, and with sufficiently rapid motion, fire can thus be started.

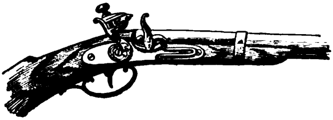
A fire "drill" came into very early use. This consisted of a pointed cylindrical piece of wood held vertically, and spun about by means of a string passing over its upper end and attached to both ends of a horizontal bar. The vertical piece passed through a hole in the middle of the horizontal bar. The pointed end of the vertical piece rested in a cavity in an easily ignited piece of wood lying on the ground. By slowly raising and lowering the horizontal bar, the slack of the string passing over the top wound up and unwound, giving the vertical piece a swift rotating motion. A considerable downward pressure was exerted and friction soon produced heat and fire at the point of contact. A shorter horizontal piece of wood, also perforated at the middle, was slipped up on the vertical piece and fastened below the longer horizontal bar. This shorter bar served as a balance wheel to keep the vertical piece rotating evenly. This fire drill is still used as a plaything among negro children in the South. Any boy can make one.

Another simple method of making fire is that of striking flint upon iron until a heated spark of iron is thrown upon tinder — any material that easily catches fire. You have often seen the sparks fly when a horse's shoe strikes against a stone. By accidentally striking a piece of iron pyrites with flint, some one discovered this way of making fire.

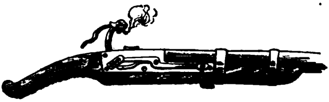
Tinder Box, Flint, and Steel

The idea was used in making the old flintlock musket carried in the Revolutionary War. A piece of flint in the hammer struck upon a piece of iron, and the spark fell into the powder pan at the base of the gun. The fire was then supposed to pass to the charge in the barrel, but often it did not, and then, of course, the gun failed to go off.

We no longer have to make use of such crude methods of producing fire. We do not need to send to the neighbor's a half mile away for a pan of coals before we can start breakfast. We strike a match and in an instant we have fire. About matches we shall have something to say later.



Flintlock



Matchlock

Chemical Nature of Fire

Only about 125 years ago was the nature of fire, or combustion, discovered. Fire is the union of oxygen (a gas found in the air) with a combustible substance, such as paper, wood, coal, or oil. This union takes place at a given temperature, known as the kindling point, and the chemical process produces heat.

Combustion takes place readily in air because air, as stated above, contains the necessary oxygen. We regulate the fire in a stove by controlling the supply of air passing in at the draft. If a lighted candle is placed in a closed jar it soon goes out. To roll a person up in a blanket or rug when his clothing is on fire is a sure way of extinguishing the flames, because it shuts off the supply of air.

Three conditions, therefore, are necessary to produce fire: oxygen, a combustible substance, and a kindling temperature. The kindling temperature is not the same for all substances. It varies from 112 to 1200 degrees Fahrenheit. If one of these three conditions is lacking, there will be no fire. Oxygen is free in the air in immense quantities and combustible materials are on every hand, but a kindling temperature is sometimes difficult to secure.

This very brief discussion of the chemical nature of fire is given, not only because it is of interest, but also because it may be of use in teaching how to avoid fire by preventing the meeting of the three conditions named above. This will be more clearly understood after a study of the later chapters.

FOR THE RECITATION

1. From what natural causes may fire originate?
2. How does fire add to the comfort and pleasure of home?
3. What indications are there that early man had a knowledge of fire?
4. Learn what you can about religious rites as related to fire.
5. Mention the ways by which fire may be produced artificially, without matches.
6. Explain the flint and steel method.
7. Look up illustrations of flintlock muskets, or see if one can be found for inspection by the class.
8. What is the chemical nature of fire? Look up Priestley, the discoverer of oxygen.
9. State the three conditions for fire.

III

What Fire Means

Destruction of the Home

If you are seated in your own home while reading this, look around at the furniture, the dishes, the rugs, window shades, books, piano or musical instruments, clothing, and the children's toys. Recall also that put away in safe places are silverware, jewelry, valuable papers, and keepsakes. The children's things are scattered from the attic to the basement, and the more valuable, but not more treasured, property of the grown-ups is also to be found in every part of the house. There are probably several people living happily in this home, and besides the people there may be one or two dogs, a cat, and perhaps a canary bird.

Now just imagine what the result is when a fire starts and destroys such a dwelling. Smoke and flames pour out of the windows, which break with the heat; the inside of the house becomes a roaring furnace; the shingles become glowing embers and are scattered by the winds. There are crashes within which show that objects are falling from shelves and walls. Every living thing within the house must seek safety outside, the family perhaps leaving everything behind. The heat becomes intense and people outside shield their faces as the house is reduced to a bed of coals and a blackened, yawning basement. If the firemen arrive on the scene, possibly the walls stand, but the ruin is none the less desolate. A burned home is a sad sight.

This picture of destruction is not an improbable one; on the other hand, such occurrences happen daily, with vast destruction of property and much loss of life.

When a building burns there is a loss of wealth. It is said that property goes up in smoke, and that is very true. The oxygen of the air attacking the combustible materials in the building gives rise to the gaseous products of combustion, which pass into the air and are driven away by the winds. One's house goes into the air, except what remains in the form of worthless ashes and non-combustible materials. This is waste. It deprives the world as well as the owner of an object of value.

Fire Insurance

"But," some one may say, "the house was insured." In this case the owner happily secures in money a part or all of the value of the building and its contents. It is not often, however, that he secures all of the value. Very few buildings are insured at full value, and then there are many articles, much prized by the owner, which have little or no commercial value, and for the destruction of

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FLEEING FROM HOUSES ON FIRE

which no insurance money is paid. Besides this, no insurance policy can cover the shock and inconvenience, the possible sickness or death brought about by a fire. But even if the owner does get back nearly all of the commercial value of his property, the insurance company loses, and where does the insurance company get the money with which to pay its losses? The company, of course, gets its funds from people who insure their buildings, so that in the end the loss is really borne by the insured people and not by the company.

Economic Results of Fire

It is sometimes said that a fire provides work. Carpenters are needed to repair and this gives employment to men who may be out of work. It is true that a fire makes work, provided the owner has enough money to rebuild; and it is possible that a man who has been out of work for a month or so may, the morning after a fire, find a job. Looking at the matter from the standpoint of this particular workman, the fire is a blessing. He was out of work, now he has work. So far as he is concerned at the moment, the fire is a godsend. It may make work, too, for the physician or possibly for the undertaker, and yet we would all agree, I am sure, that it is a misfortune for a person to be injured or killed in a fire.

Accidents, sickness, misfortunes, and fires give some people work, but, nevertheless, they are calamities. It would be much better for society to insure the workman against non-employment, as is done in England and other countries today, than that he should earn wages by rebuilding the waste of preventable fire; for, in the end, the total wealth of society is reduced by fire.

Annual Fire Waste

The total waste by fire in the United States every year is enormous. During the past ten years the average loss has been two hundred and fifty million dollars per year. This ten-year period includes the great fires of San Francisco and Baltimore, so the average is somewhat above the ordinary annual loss.

In 1914, according to the New York *Journal of Commerce*, the loss was $221,439,350, not including losses from prairie fires and marine losses by fire. This sum of money is too large for the imagination. The building of the Panama Canal required the labor of thousands of men for about ten years, yet the money required for this work was only twice the amount of our annual fire loss. With this fund $2.50 could be put into the pocket of each person in the United States. Suppose this sum were in the form of one-dollar bills. These bills placed end to end, in rows of seven, would reach from San Francisco to New York City. In other words, a footpath nearly two feet wide could be made of the bills across this continent. Such is the waste which fires, largely preventable, bring upon the nation every year.

But these facts do not tell the full story. There should really be added to this quarter of a billion of dollars many millions more. The support of fire departments is estimated to cost $100,000,000 a year, and the amount of money paid to fire insurance companies in the form of premiums exceeds by $141,000,000 the amount which the companies pay back for fire losses. Hence we have $241,000,000 spent annually upon fire prevention.

Nor do these figures include the economic loss represented by injuries and deaths. In the state of Illinois, in 1913, nearly 400 people lost their lives through fire. In the United States, 1500 people are killed and 5000 injured annually as a result of fire.

Waste is to be avoided in all of its forms, and of all wastes that of fire is one of the greatest and also the least excusable. Such waste should be prevented by every known means. We have no right, through our carelessness, to deprive others of the use and enjoyment of property. Buildings should stand for many years, but fires annually consume one-half the value of all new buildings.

The annual fire loss, including the cost of protection, would support the public school system of the United States for a year. Let the schools therefore teach the evils of this waste and how to prevent it, and thus contribute indirectly to the financial support of public education.

The per capita fire loss, or loss to each person, in the United States is large as compared with most other countries, as the following table shows.

	Number of cities reporting loss in 1913	*Per capita loss*
United States	298	$2.25
Austria	4	.25
Canada	6	2.46
England	14	.33
France	5	.49
Germany	8	.28
Italy	5	.25
Russia	2	.89
Scotland	3	.36

Conflagrations, or great fires, often bring the per capita loss up to much higher figures, and, unfortunately, conflagrations are not rare. The following table from the Proceedings of the 48th Annual Meeting of the National Board of Fire Underwriters shows cities in which the per capita loss is very large.

CITIES IN WHICH LOSS EXCEEDED $5.00 PER CAPITA IN 1913

Columbus, Ga.	$40.91	Elmira, N. Y.	$8.49
Ottumwa, Ia.	16.39	Jackson, Miss.	7.58
Cohoes, N. Y.	15.43	Parkersburg, W. Va.	7.50

Savannah, Ga.	$13.91	Norwood, Ohio	$7.30
Port Huron, Mich.	13.72	Walla Walla, Wash.	6.99
Quincy, Ill.	13.26	Columbia, S. C.	6.50
Salem, Mass.	12.08	Binghamton, N. Y.	6.45
Gloversville, N. Y.	11.81	Springfield, Mo.	6.42
Dayton, Ohio	11.60	Little Rock, Ark.	6.31
Dubuque, Iowa	10.43	Peoria, Ill.	5.83
East St. Louis, Ill.	10.12	Boston, Mass.	5.79
Lynchburg, Va.	9.94	Fresno, Cal.	5.52
Everett, Wash.	9.69	Burlington, Vt.	5.39
San Jose, Cal.	9.39	Stockton, Cal.	5.33
Shreveport, La.	9.17	Flint, Mich.	5.01
New Rochelle, N. Y.	8.69		

The *Journal of Commerce* is authority for the following table of the annual fire losses in the United States for 40 years, 1875 to 1914 inclusive.

Year	*Aggregate Property Loss*	*Year*	*Aggregate Property Loss*
1875	$78,102,285	1889	$123,046,833
1876	64,630,600	1890	108,993,792
1877	68,265,800	1891	143,764,967
1878	64,315,900	1892	151,516,098
1879	77,703,700	1893	167,544,370
1880	74,643,400	1894	140,006,484
1881	81,280,900	1895	142,110,233
1882	84,505,024	1896	118,737,420
1883	100,149,228	1897	116,354,575
1884	110,008,611	1898	130,593,905
1885	102,818,796	1899	153,597,830
1886	104,924,750	1900	160,929,805
1887	120,283,055	1901	165,817,810
1888	110,885,665	1902	161,078,040

1903	$145,302,155	1909	$188,705,150
1904	229,198,050	1910	214,003,300
1905	165,221,650	1911	217,004,575
1906	518,611,800	1912	206,438,900
1907	215,084,709	1913	203,763,550
1908	217,885,850	1914	221,439,350

FOR THE RECITATION

1. Does insurance really repay the loss of burned property? Discuss.

2. Comment upon the view that fires are a benefit to labor.

3. How should one regard all preventable fire losses?

4. What is the average annual loss by fire in the United States?

5. How much land at $75 an acre would this sum purchase? How many automobiles at $1,000 each?

6. Find what it costs to support the fire department in your town or city. Find the annual cost of insurance of your home.

7. Is loss of life an economic loss? Explain.

8. Where do insurance companies obtain their funds?

9. Comment upon some feature of the tables given.

IV

Matches and Fires

Convenience of Matches

SINCE the invention of the friction match in 1827, it has been a very easy matter to start a fire. In fact, it has been perhaps too easy, because one of the most frequent causes of fire loss is the match, especially the so-called parlor match.

A hundred years ago, when the fire went out it was usual to send to a neighbor's to get coals; but great pains were taken not to let the fire go out. The fire was kept from going out by covering the coals in the fireplace with ashes. But, very naturally, once in a while somebody forgot, and then it was necessary to go to the neighbor's for fire. Father could light a fire, however, by pouring powder on tow and then striking a spark with flint and steel. But how inconvenient as compared with striking a match!

Kinds

In common use today are the parlor match and the safety match. The parlor match is said to have been so named from its having been used at first only when company was present in the parlor. The safety match, as its name indicates, does not easily ignite, and is not often the cause of destructive fire. It is the only kind of match allowed in most European countries, the sale and use of the dangerous kind of matches being forbidden by law. In our own country the state of Wisconsin and some other states have similar legislation. It is interesting to know that in the United States safety matches cost only about half as much as the dangerous parlor matches.

Chemical Composition

The head of the parlor match is made of a combination of phosphorus, rosin, chlorate of potash, whiting, and powdered flint, held together by glue. A very little friction makes the flint hot enough to fire the phosphorus, which burns at a temperature of 112 degrees Fahrenheit. The oxygen is freed from the chlorate of potash with an explosion and heat. The rosin takes fire and the match stick, soaked in paraffin, burns.

A silent and slow burning match is made by using saltpetre or sulphur in the place of chlorate of potash.

In the safety match the phosphorus, instead of being put into the head of the match itself, is placed — in combination with other elements — on the side of the box, so that in order to light the safety match it is necessary to strike it upon this specially prepared box.

Care of Matches

Matches may be ignited in many ways, and the utmost care is necessary in their use. If people realized the danger of matches, they would not leave them lying about loose, but would keep them in metal or glass containers. It is not uncommon to see on a shelf a half-open box of matches, with some scattered about. Matches should never be carried loose in the pocket. In the home it is well to have the supply of matches in just one place on each floor, and this place should be out of reach of small children. Matches may be lighted by being stepped upon, by being caught in a drawer, or struck by a descending window. The sun's rays coming through a rounded glass surface, as a fish globe, a round paper-weight, or a bubble in the window pane, will light matches. Rats and mice start fires by nibbling matches. A match should be looked upon as a dangerous object and handled accordingly.

In one year, of 3875 fires in Chicago whose causes were known, 1089 were due to carelessness in the use of matches. Fires often start from match stubs that are still burning. The practice of throwing burned matches into the waste paper basket is particularly dangerous.

Children are curious about matches and long to play with them. If they are strictly forbidden to touch matches, probably when not watched they will get hold of them and light them. It would seem wiser to allow children to light matches occasionally, under supervision. This satisfies their desire to start a fire and makes it less likely that they will hunt up matches to play with when left alone. Many children are burned to death through setting their clothing on fire.

It is said that the people of the United States use as many matches as all of the rest of the world combined, and that in this country alone 10,000 matches are scratched every second.

For the Recitation

1. What is the parlor match?
2. The safety match?
3. Has your state passed a law requiring the use of safety matches only?
4. Where should matches be kept?
5. Comment upon the practice of carrying matches loose in the pocket.
6. See if matches can be ignited by blows of a hammer, or by being stepped on.
7. Dry out wet matches and see if they will light.
8. Do you know of any fires caused by the careless use of matches? Describe.
9. See how long various kinds of match heads hold their heat after being blown out.
10. Compare the number of safety matches and parlor matches that can be bought for five cents.

V

The Dangers of Kerosene

Source and Nature of Kerosene

KEROSENE and gasoline are two of the many useful products obtained from crude petroleum, a natural oil found in several of our states and also in other parts of the world. When it first comes from the earth, petroleum is very dark in color and has a disagreeable odor. It is, of course, full of impurities, but by a process called *refining*, these are removed and the oil is separated into many different products.

The chemical composition of kerosene and gasoline is such that in liquid form they burn only at the surface, and do not explode. They do not contain oxygen. When tanks of oil are set on fire, they pour off dense clouds of smoke and burn slowly, because oxygen is supplied only at the surface. In the oil regions, burning tanks of oil are extinguished by directing a mass of soap suds across the surface. The soap suds cut off the supply of oxygen.

Unlike gunpowder and dynamite, which contain oxygen and therefore explode, kerosene and gasoline are comparatively safe except in the form of vapor mixed with air. Thus supplied with oxygen, the vapor becomes highly explosive and is consequently dangerous. These facts should be borne in mind in dealing with lamps and stoves.

Care of Lamps

The use of kerosene oil for lighting makes it important to understand its nature and the dangers which arise from lamps. The oil creeps up the lamp wick to its top, where the flame is kept within bounds by a metal burner. The wick should fit tightly in this metal burner; otherwise the flame may run down the wick and ignite the kerosene vapor in the body of the lamp, causing an explosion. Unclean burners are dangerous because they prevent the heat from passing off quickly, thus causing the lamp to become overheated. With a tight-fitting wick, a clean burner, and a well-filled bowl there is little danger of an explosion. The lamp should *never* be refilled when it is lighted, or when near a fire.

It is dangerous to burn a kerosene lamp all night, as after many hours of burning it is especially liable to explode. The oil in the lamp gets low and the bowl becomes filled with an explosive vapor. Accidents to lamps are also likely to happen at night, as in a case reported from Fulton County, Illinois. A cat jumped upon the table, overturning a lighted lamp, with the result that the house was destroyed.

There is much danger from falling lamps. Many of the fires caused by kerosene are due to the placing of lamps insecurely. They should not be set down on the edge of a table or upon a rickety stand. If a lamp falls it is almost sure to break, scattering blazing oil in every direction.

How to Extinguish an Oil Fire

Should a lamp explode, water should not be thrown upon the blazing oil, as this spreads the fire. Oils are lighter than water and float on its surface. The worst thing to do in the case of an oil fire is to cause the blazing oil to float to various parts of the room. Woolen blankets or rugs should be used to smother the fire.

Starting Fires with Kerosene

It is a common practice to start fires with kerosene, and there are persons who pride themselves upon never having had an accident in using kerosene for this purpose. But there is danger, and sooner or later an accident is almost certain to occur. This is particularly true if the stove is warm or if there are coals present.

If kindlings are soaked in kerosene and put into the stove and left there for any length of time, a gas will form in the stove and when the lighted match is applied there will be an explosion.

A large number of deaths occur every year from starting fires with kerosene.

For the Recitation

1. What is petroleum?
2. How does kerosene burn?
3. Why does oil rise in the wick?
4. Why should lamps be kept clean?
5. Give suggestions for filling lamps.
6. Why are lamps liable to explode when nearly empty?
7. Examine a lamp burner or lamp in class.
8. Comment upon the practice of using kerosene to start a fire in the stove.
9. What would be the probable result of attempting to light kindlings saturated with oil, after they had been shut up in the stove for some time? Discuss.
10. Consult reports giving the number of serious fires caused by kerosene.
11. What conditions are necessary for an explosion?
12. Why does liquid kerosene burn only at the surface?
13. How should you put out an oil fire?

VI

The Dangers of Gasoline

THE most dangerous product of petroleum is gasoline, which even at ordinary temperature gives off an explosive vapor. The vapor from one pint of gasoline will saturate 200 cubic feet of air and make it explosive. Air mixed with about ten per cent of gasoline vapor is more dangerous than gunpowder. Gasoline vapor is somewhat heavier than air; it therefore falls to the floor, where it may be moved about by drafts. If the air is still, the danger that a large amount of gasoline vapor will accumulate in one place is increased.

Gasoline vapor is especially dangerous to life. In the United States an average of 30 persons a week die from gasoline burns, and twice that number are injured. Gasoline is one of the most frequent causes of fire. The total loss from this source runs into many millions of dollars every year. The laws of some states require that gasoline shall be kept in containers painted red and labeled "gasoline" in letters of a contrasting color. In some states red tags are attached to all receptacles for gasoline. Many accidents occur from mistaking gasoline for other liquids, especially kerosene. People sometimes mistake gasoline for kerosene when filling lamps or starting fires.

Use of Gasoline in Cooking and Lighting

Gasoline is often used for cooking. Great care should be used to avoid explosions. The tank of the stove should never be filled near a lighted lamp or other flame. No leak should be allowed in valves or tanks. Never keep gasoline in the house or in the basement. The storage tank should be air-tight, so that no vapor will escape. In using the gasoline cook stove, care should be taken not to allow anything to boil over and extinguish the flame, thereby allowing the vapor to escape or to be lighted from other burners. One should not leave the kitchen for any length of time when cooking with gasoline.

The gasoline lamp is regarded as one of the most dangerous types of lamps. If gasoline must be used, the best way is to generate the vapor outside of the house.

Cleaning with Gasoline

In cleaning grease spots from clothing with gasoline, one should see that there is no lighted lamp, cigar, or other kind of fire near. Persons have been burned when cleaning gloves with gasoline. The vapor has been known to ignite from an electric spark due to friction. Gloves and clothes should be taken outdoors for cleaning, and gloves should not be on the hands when cleaned.

It is unsafe to allow gasoline to flow into drains, as the vapor mixes with the air in the pipes and may cause an explosion. In the case of both kerosene and gasoline, as stated in the preceding chapter, the greatest danger arises when the vapor mixes with air, for the oxygen in the air supplies the condition favorable for explosion.

Recent Accidents with Gasoline

The danger of gasoline explosions is illustrated in a number of accidents of recent occurrence. An Illinois woman, after cleaning a bed with gasoline, carried a lighted lamp into the room. An explosion occurred instantly, injuring the woman and setting fire to the house.

The owner of an automobile had his clothing saturated with gasoline while working under his machine. On his way to the garage his clothing suddenly burst into flame, caused probably by a spark struck by the nails of his shoes as they hit the pavement. Flames enveloped the man and he died from burns.

A mechanic in North Dakota, who was about to repair an empty gasoline tank, held a light inside to aid him in his work. There was enough gasoline vapor present to cause an explosion, killing the mechanic instantly.

It is said that gasoline is as dangerous to handle as dynamite. No one should ever take a lantern or other fire near an overturned or wrecked automobile, as the air may be filled with explosive vapor.

FOR THE RECITATION

1. What is the nature of gasoline vapor?
2. What precaution should be taken in regard to gasoline containers?
3. Is there a law on this subject in your state?
4. Can you distinguish gasoline for kerosene by the senses? Try the experiment.
5. Give cautions for the use of gasoline for cooking.
6. Tell how to avoid danger in cleaning clothing and gloves with gasoline.
7. Suggest situations not described in the text in which gasoline vapor might result in serious harm.

VII

Spontaneous Combustion

In Lawrence County, Illinois, a nine thousand dollar church of the United Brethren was recently destroyed by a fire caused by spontaneous combustion. On the day before the dedication of the church was to have been held, the interior was cleaned by a number of women. Cloths saturated with a mixture of turpentine, linseed oil, and gasoline — a combination for polishing floors and woodwork — were used. The cloths were then stored in a small closet and fire resulted through spontaneous combustion.

What It Is

What is spontaneous combustion? We know, of course, that when oxygen unites with another substance heat is produced. As there is so much oxygen free in the air, this process, which we call oxidation, is constantly going on around us. Therefore, it is easy to see that if materials which burn easily are crowded into so small a space that the heat which is generated cannot escape readily, it will accumulate until the kindling temperature of the combustible materials at hand is reached. When the three conditions necessary to produce fire (as studied in Chapter II) are brought about in this way, the process is known as *spontaneous combustion.*

Spontaneous combustion is the cause of many fires every year. Many of the "mysterious" fires and those supposed to be started by tramps are undoubtedly due to this cause. In the state of Minnesota, in 1913, there were 69 known cases of spontaneous combustion, with a property loss of nearly a quarter of a million dollars. In the same year there were 107 known cases of spontaneous combustion in Indiana, with a property loss of more than seven hundred thousand dollars.

Dangers from Oils

In the case of the church mentioned above, the conditions were ideal for a fire from this cause. Linseed oil has a strong affinity for oxygen and unites with it upon contact. When exposed to the air the oil unites with the oxygen slowly and gives out heat. If the heat is radiated away so that it does not accumulate in sufficient quantity to raise the temperature of the oil to the kindling point, there is no ignition, but if the oil is spread upon rags, shavings, or porous material, and the conditions are such that the heat is not radiated away, the union of the oil with oxygen finally results in a kindling temperature, and a flame is produced.

An acquaintance of the writer reports that his residence narrowly escaped burning from this cause.

Cloths which had been used to apply linseed oil to hardwood floors were thrown into a barrel in a corner of the basement. An odor was detected and the cloths, then too hot to be touched with the hand, were taken to a place of safety. The barrel held the heat which slowly accumulated from the union of oxygen with the oil on the rags.

There are some other oils which, like linseed oil, easily unite with oxygen. Among these are walnut, poppy seed, and cottonseed oil. Vegetable oils are more likely to cause spontaneous combustion than are either mineral oils or oils derived from animal fats. Great care should be used in disposing of oily waste, cleaning cloths, and the greasy clothing of painters, engineers, and mechanics. The so-called dustless mops, which are treated with oils, are a source of danger and should be kept in a proper place.

Dangers from Hay, Grains, etc.

It is well known that barns may be burned by the spontaneous combustion of hay. A case is reported of a workman who, as an experiment, placed an unlighted match in a cock of new hay in a field. In a few moments the hay was in flames. Hay, especially clover, should not be placed in barns before it is dry, for sufficient heat may be produced, during the process of drying, to start a fire which is soon beyond control.

Spontaneous combustion frequently takes place in straw, as straw often contains weeds which dry slowly. The fermentation of hops produces heat. Bins of grain and seeds, if moist, are a source of danger. Fires have been known to start in fodder heaps, where timbers used as props have served as flues to a heat center. Heat is generated in manure heaps, but as this material does not burn easily, there is not much danger of fire.

Sawdust, when saturated with glue, oils, dyes, and similar materials, and stored in large heaps, will often ignite. Nitric acid will cause sawdust to take fire.

Charcoal and lamp black unite readily with oxygen and should therefore be stored with care. Moisture aids the spontaneous ignition of these substances. Spontaneous combustion occurs in masses of moist coal, especially when the coal contains sulphur compounds, or when coal dust is present.

One authority lists the following groups of substances in which spontaneous heating and combustion occur:

Coal, lignite, briquettes, coke, lampblack, peat.

Wood, sawdust, dye-woods, wood charcoal, cork dust, insulating materials, leather.

Colors, varnishes, resins, lacquers, oils, dryers, fats, disinfecting powder, lacquered substances, oilcloth.

Fire lighters, matches, gas-purifying materials, soda residues, slag heaps.

Metallic powders, drill turnings, burnt lime, carbides, carriers of oxygen.

Nitric acid, nitro compounds, sulphur compounds.

Artificial manures, stall manures, fish guano, superphosphates.

Hay, clover, grass, malt, malt culms, cereal grains, bran, hops, tobacco, seeds, concentrated fodder and mixtures of the same.

Wool, cotton, silk, flax, hemp, jute, tow, rope.

Oily rags, greasy cloths, polishing rags, polishing discs (buffing wheels), articles of clothing in a greasy or dusty condition.

For the Recitation

1. What were the fire losses of Minnesota and Indiana, in 1913, due to spontaneous combustion?
2. What is spontaneous combustion?
3. Using linseed oil and cotton waste, try a laboratory experiment in spontaneous combustion.
4. Of what is paint made?
5. Suppose a painter were to place a roll of paint cloths in his pocket when working in the sun. Discuss possible results.
6. What is meant by the radiating away of heat? Apply to spontaneous combustion.
7. What kinds of oil are most likely to cause spontaneous combustion?
8. Report observations of substances heating spontaneously.
9. What should be done with oiled dust cloths?

VIII

Chimneys and Stoves

As many fires occur from defective chimneys, it is important that the construction of chimneys should receive careful consideration and that chimneys already built should be inspected.

How Chimneys Should be Built

All chimneys should be built from the ground up. It is unwise to support chimneys or flues on iron or wooden brackets. No chimney should be started upon a floor or built upon a beam. In case a chimney is not built from the ground up, there is danger of sagging and the opening of crevices in the wall.

Authorities are agreed that the chimney wall should be two courses of brick or eight inches in thickness. But the wall may be one course of brick if lined on the inside with well-burned terra cotta chimney-tile set in Portland cement mortar, the lining to be continuous from the bottom to the top.

Where the chimney wall is but one brick in thickness, the crumbling away of the mortar may produce dangerous cracks. The chimney foundation should be at least a foot wider all around than is the base of the chimney. If placed in the outer wall, it should be well below the frost line.

Chimneys should extend at least three feet above flat roofs and two feet above the ridge of peaked roofs. Cement mortar should be used above the roof, as rains wash out ordinary mortar, leaving cracks between the bricks.

Inspection and Testing of Chimneys

Chimneys should be frequently inspected. Closed attics should be avoided and in some cities are prohibited by law, as they prevent inspection. The part of the chimney which passes through the roof should be protected with especial care.

It is a good plan to test the chimney occasionally. This may be done by covering the top of the chimney and then burning rags or grass in the clean-out place or in the stove or heater. If there are any openings in the chimney walls, they will be disclosed by the escaping smoke.

Suggestions Regarding Stoves and Stovepipes

Serious fires often start from stoves and stovepipes, and many of these might be prevented if care and judgment were used in matters such as the following:

A metal stove board should be placed under the heating stove, and all woodwork within two feet of the stove should be protected. In many homes one sees woodwork that is blistered by a stove placed too near. If this occurs in ordinary use, think what might happen if, in the absence of the family, the stove became red hot.

Towels or articles of clothing should not be hung where they may catch fire from hot stove lids.

Sheet-iron wood stoves should not be used with less than three inches of ashes in the bottom.

A cracked stove is dangerous, because the coals are often exposed.

An undersized stove is dangerous, because it must be overheated in order to produce results such as a larger stove would produce without forcing.

Stovepipes should enter the chimney at right angles. They should be held rigidly in position by wires, and should be kept tight at the joints. Stovepipes should never pass through closets. Where a stovepipe passes through a wooden partition, a ventilated thimble with air space around the pipe should be used.

Do not place paper over flue holes or stuff them with rags. All unused flue openings should be closed with metal caps.

The stovepipe should be frequently cleaned. When the soot in a pipe or chimney takes fire, the house is in danger. The chimney, if only one brick in thickness, becomes hot and sparks pour out upon the roof of the house or are blown about by the winds. Chimneys should be built with a clean-out in the basement and accumulations of soot should be removed.

Value of Fireproof Roofing

The danger from a chimney fire is greatly increased if the house has a shingle roof. Especially when it is old and mossy, the shingle roof is likely to catch fire quickly from sparks. The burning shingles may then be blown for considerable distances and start other fires.

Within the fire limits of many cities shingle roofs are not permitted, and it has been strongly urged that such non-combustible materials as asbestos, slate, or tin be used in the place of wooden shingles.

The National Fire Protection Association urges its members to unite in their home cities and towns in a campaign for the abolition of the shingle roof.

FOR THE RECITATION

1. Give directions for building a good chimney.
2. How may chimneys become cracked?
3. Inspect the chimney at home and report.
4. How may chimneys be tested?
5. How should stovepipes be set up?
6. Why is soot a source of danger in stovepipes?
7. What danger in an undersized heating apparatus?
8. How should flue openings be closed?
9. Why are shingle roofs objectionable?
10. Find out the relative cost of shingle and non-combustible roof coverings.
11. Procure, if possible, samples of fireproof roofing.

IX

The Use of Gas and Electricity

In many homes gas is used for lighting and cooking. It is well, therefore, for everyone to know the dangers of gas and how to avoid them. When mixed with oxygen, gas burns and explodes. It may also cause death by suffocation.

Suggestions Regarding Gas Jets

There is a time-honored warning not to blow out the gas. This warning is sometimes, through ignorance, unheeded. People familiar with lamps and not accustomed to gas jets have a tendency to blow out rather than turn out the gas when using rooms thus lighted.

Great care should be taken with gas jets. When a jet is left open gas quickly fills a room. A light turned low may go out because of a temporary lessening of the pressure, and later the gas will escape, possibly to be ignited and explode from another fire. Curtains may be blown against a lighted gas jet by the wind and take fire. A gas jet should be at least three feet from the ceiling. Swinging gas brackets are a source of danger as leaks may occur in the elbows, or the bracket may be moved too near the wall.

Suggestions Regarding Gas Stoves

The use of gas for cooking leads to accidents and fires. A rubber tube connection is unsafe because rubber becomes inelastic and cracks with age, allowing the gas to escape. Children often pull off rubber tubes. The wind may blow out the gas, and if another burner is going an explosion may occur. The cut-offs on gas ranges are interesting to children, and they are likely to play with them, especially if the keys turn easily. Loose keys are frequently opened by accident, in passing the stove. They should be kept tight. Boiling liquids overflowing a vessel may put out the gas, which continues to flow.

Iron pipes and rigid gas fixtures should be used, if possible. Where movable connections are necessary, the gas should be turned off where the tube joins the gas pipe. It is unsafe merely to turn off the gas at the burner.

The smell of gas is a danger signal. The doors and windows should be opened. Put out any light that is burning. Do not look for a gas leak with a lighted lamp, candle, or match. There is great danger from gas escaping in a cellar, especially if there is a furnace or a hot water heater in operation.

Fire insurance policies do not cover losses by gas explosions. If an explosion causes a fire, the damage done by the fire will be made good by the insurance company, but when an insured building is injured or destroyed by a gas explosion, the owner receives nothing. This is an additional reason for being careful with gas.

Uses and Dangers of Electricity

Electricity is coming into everyday use in our homes. It is used for lighting, heating, cooking, and many other purposes. The electric iron is found wherever electric current is available. If the current is left on when the iron is not in use the iron becomes overheated and may ignite the covering of the ironing board, eventually setting fire to the house.

The practice of using paper or cloth shades on electric light bulbs is unwise. Lights of large candle power produce enough heat to char and ignite paper. A bulb hanging against a window casing will blister the varnish.

Insulation

The proper insulation or protection of wires carrying electric current is of the greatest importance. The covering of wires should be of the best quality when it comes from the factory, and care should be taken that this non-conducting material does not become water-soaked or worn off. A recent inspection in fifty cities in Illinois brought out the fact that electricians were installing quantities of wire whose insulation was unfit for use. Wire which could not be used in cities having good electrical inspection was found to have been disposed of in towns having no electrical inspection. As defective wiring is a frequent cause of fires, no expense should be spared in securing the very best insulation. The National Fire Protection Association, Boston, publishes a national electric code giving the rules and requirements of the National Board of Fire Underwriters for electric wiring and apparatus.

Where cords are suspended over nails, as is often the case in using electric lights, electric washing machines, or electric irons, the insulation may become worn and cause a short circuit. This means that the electric current, instead of making its full course, passes directly from one wire to the other. The heat thus developed may start a fire.

When a house is built, there should be the most careful inspection of the placing of the electric wires. These wires pass through the floors and walls, often being carried through boards and timbers. The only protection against fire is in using wires that are properly covered and kept away from direct contact with woodwork.

FOR THE RECITATION

1. What is suffocation?
2. What danger may arise from leaving a gaslight turned low?
3. Give cautions regarding the use of swinging gas brackets.
4. Why are rubber tube connections unsafe?

5. What should be done first upon noticing the odor of gas?

6. Do fire insurance policies cover losses due to explosions?

7. What is insulation?

8. How may ironing boards be set on fire?

9. Comment upon the use of paper shades on electric light bulbs.

10. Interview an electrician on the subject of defective wiring.

11. Where may rules for wiring be obtained?

12. Why should electric cords not be hung over metal supports?

13. Suppose a loop of insulated wire were used to suspend the cord. Discuss.

14. What is a short circuit?

15. Visit a building in course of erection and observe the electric wiring.

X

Christmas Trees and Bonfires

The use of candles on Christmas trees is responsible for thousands of fires, in many of which children are seriously or fatally burned. The custom of having a Christmas tree is so firmly established that probably nothing except a lack of trees would prevent this kind of celebration at Christmas time. It is necessary, then, to use the utmost care during the holiday season.

Conditions Ideal for Fire

The Christmas tree is generally decorated with inflammable materials, such as paper and cotton. Cotton is used to represent snow, and Santa Claus, of course, wears cotton-batting whiskers! Many of the presents are wrapped in tissue paper. The wood of which the children's toys are made burns very readily. Then, too, the needles and branches of the tree itself, when exposed to the warm and dry atmosphere of the house, become like kindlings, and the whole tree burns fiercely if ignited.

The children will wish to get matches and light the candles, and this, of course, they should not be allowed to do except under the eyes of their elders, for in their excitement they may set fire to their clothing or to the tree. If candles must be used, metallic tinsel and other non-inflammable decorations should be the only ones permitted.

Safety Pays

Electricity is now in such widespread use that those who have it in their homes should replace the Christmas candles with tiny colored electric bulbs. These are almost as attractive as the candles, and the absolute safety with which the children may play around a tree thus lighted will more than repay the cost of the outfit.

In the reports of the fire marshals of the different states, among the causes of fire frequently mentioned is the Christmas tree. Every precaution should be taken lest this period of Christmas happiness be turned into a season of mourning.

The Bonfire

The bonfire, as the name suggests, is a "joyful fire." Children like nothing better than to throw paper and leaves upon such fires. In the spring and fall thousands of bonfires are lighted, and the children always want to be near.

Dangers

There is great danger of the children's clothing getting alight from bonfires. The outer wraps of children are sometimes made of fleecy materials over which a blaze runs with great rapidity. Often the wind blows the flames in an unexpected direction, so that the only safe way is to stay out of reach of the flames on all sides of the fire. If the clothing does get afire, and the child is frightened and runs, as is usually the case, the danger is greatly increased and may have serious results. The quickest and surest way of putting out fire on the clothing is to roll in the grass or smother the flames with a woolen coat.

Precautions

A responsible person should see that a bonfire is never left until the last ember is out. If there are buildings or dry fields near, water should be thrown upon the smouldering ashes when the fire is left, as the wind may cause a fire which is apparently dead to start up again. Some materials smoulder for hours, so it is always safest to use water.

FOR THE RECITATION

1. Should the Christmas tree be allowed to remain long in the house? Explain.
2. Who should light the candles?
3. What combustible materials are often used on trees?
4. Test materials sold as non-combustible.
5. Why should a tree be securely set up?
6. What might happen if the tree when lighted were in a strong draft?
7. In public celebrations with Christmas trees what conditions might produce a panic?
8. What are the dangers of panic?
9. Why should children be kept away from bonfires?
10. What may happen if any embers are left burning at bonfires?

XI

The Celebration of Independence Day

Why We Should Celebrate

It is right to celebrate the anniversary of the Declaration of Independence. The 4th of July, 1776, is a date which will always mean much to intelligent citizens of the United States. Our people cannot be reminded too often of the splendid ideals of the Revolutionary period — ideals to which the finest spirits in France and America were devoted. Nothing could afford a more wholesome influence upon the young men and women of today than an intelligent appreciation of what Independence Day means. The Declaration of Independence is a declaration of human rights, and for this every citizen should show his gratitude.

It would be a great mistake to forego the national observance of Independence Day. It is important that the celebration be continued and that the largest educational use of the day be made. The 4th of July is unfortunately identified in many minds with racket, explosions, lockjaw, runaways, and fires. It would seem as if the day were devoted to the gods of destruction rather than to a political ideal. There is really no necessary connection between patriotism and firecrackers. In fact, one suspects that the greater the tumult of the day the less real thought is given to its historical meaning.

Fireworks

Fireworks of the noiseless variety are artistic and beautiful. The Chinese, who have no Independence Day, are devotees of fireworks. In the southern states fireworks are used at Christmas. In England Guy Fawkes day is thus celebrated. Night exhibitions outside of city limits and with proper precautions are proper and enjoyable.

There is little to be said, however, in favor of firecrackers of either the small or the cannon variety, or of the blank cartridge and the toy pistol. The use of fireworks at all hours of the day and at all places is most objectionable. Some cities by ordinance now prohibit the use of fireworks. The movement for a safe and sane 4th of July, inaugurated in several of the large cities, notably Chicago, has become national in scope. With a further development of public sentiment, the old style 4th of July will become a thing of the past.

Accidents

The dangers from an unwise celebration of Independence Day are many. One of the earliest recollections of the writer is that of a young man who had an arm blown off by a charge of powder used in celebrating. The lists of killed and wounded following every 4th of July celebration read like the records of battlefields. Fingers, thumbs, and arms are blown off, eyes are put out, and the deadly tetanus or lockjaw germ finds many victims.

Fires

Fireworks start fires. The laws of combustion are not suspended on Independence Day. A fire balloon landing upon a shingle roof or a grain stack is quite likely to start a fire, as are also ill-aimed sky rockets and Roman candles. Firecrackers started a fire which destroyed two-thirds of the city of Portland, Maine — a place of more than fifty thousand inhabitants — with a property loss of ten million dollars. Fire departments are kept unusually busy on this day and every sane person breathes a sigh of relief on the fifth.

The following table from the *Journal of the American Medical Association* shows the number of 4th of July casualties for a ten-year period.

Year	*Dead*	*Wounded*	*Total*
1903	466	3,983	4,449
1904	183	3,986	4,169
1905	182	4,994	5,176
1906	158	5,308	5,466
1907	164	4,249	4,413
1908	163	5,460	5,623
1909	215	5,092	5,307
1910	131	2,792	2,923
1911	57	1,546	1,603
1912	20	659	679
	1,739	38,069	39,808

A Suggestion

What we need is not to appreciate the signing of the Declaration of Independence less, but more; and we need to appreciate it in a finer way. Mere noise signifies but little. Everyone may help bring about a more intelligent and enjoyable recognition of our greatest national holiday.

For the Recitation

1. What is the significance of July 4th?
2. Look up the history of its observance.
3. Read the Declaration of Independence and decide how the signing of such a document should be celebrated.
4. Look up the recent movement for a sane Fourth.
5. What kinds of personal injuries are liable to be inflicted by fireworks?
6. How may fireworks start fires?
7. Account for the improvement shown in the table above since 1909.
8. Consult copies of newspapers appearing just after the Fourth.
9. How can you help to make Independence Day safe?
10. What is the practice in your town or city?

XII

Fires Caused by Lightning

ONE summer afternoon a few years ago a woman drove into a small New York town and excitedly said that one of the buildings on her farm was afire. A number of men climbed into the wagon and the heavy farm horse, panting and exhausted, was driven as rapidly as possible uphill to the burning building, a mile or two out of town. But they reached the spot too late to do more than merely look on while a fine new barn and its contents, including a number of cattle, were burned. It was a most distressing sight, and the money loss was large. This is only one instance out of thousands that might be related about buildings that are struck by lightning and burned annually.

Protection Against Lightning

The question arises as to the safeguarding of buildings from fires thus caused. If there is any way of protecting buildings from lightning, surely it should be known and used.

Fortunately, lightning rods are now known to give efficient protection. They have not always had a good reputation. Frauds have been practiced upon the public by lightning rod agents. But now science comes forward with the assurance that lightning rods properly installed do protect.

Cause and Nature of Lightning

First, let us see what conditions bring about lightning. When one cloud is more highly charged with electricity than another or than the earth, the electricity may be discharged through the air from one cloud to the other or from the cloud to the earth. The sudden expansion of the air as the electric current passes through it causes the sound known as thunder.

Air, being a poor conductor of electricity, resists the passage of the lightning, and the result is often seen in the zigzag course of the so-called forked lightning. The electric discharge takes the easiest path from the cloud to the earth, and as trees, buildings, and other high structures offer less resistance than the air, the danger of these objects being struck is apparent. When a building is struck, the electric current often causes sufficient heat to set the building on fire. Structures may also be shattered by the mechanical force of the current.

The lightning rod provides an easy route for the passage of the current into the earth, and thus it protects the building to which it is attached. When a cloud is electrified positively, there is a corresponding negative charge induced in the earth beneath. It has been demonstrated that rods help to equalize the electrical strain and prevent the occurrence of a spark or flash.

Efficiency of the Lightning Rod

Recent investigations give definite evidence of the protection that lightning rods actually accomplish. An investigator in the United States Weather Bureau service found that out of 1845 farm buildings struck by lightning in 1912–13, only 67 had rods. Since 31 per cent of the buildings were rodded, the loss would have been 572 instead of 67 if rods had afforded no protection.

Professor Day, of the Ontario Agricultural College, found that in Ontario in 1912 the efficiency of rods was 94½ per cent and in 1913, 92 per cent. In Iowa an efficiency of 98.7 per cent and in Michigan an efficiency of 99.9 per cent has been found.

Where rodded buildings are struck by lightning, it is believed that the installation is usually imperfect. With properly installed rods it is probable that buildings would rarely, if ever, be struck.

The fire marshals of the United States are unanimously of the opinion that lightning rods prevent lightning fires. In Illinois, in 1913, there were 419 lightning fires, not one of which occurred on a building properly rodded. Insurance companies, especially farmers' mutual companies, recognize the protection afforded by rods and often charge a lower premium when property is thus protected. A reputable firm in Chicago, which has installed lightning rods for more than thirty years, agrees to pay $500 in case a building which it has rodded is struck by lightning, and makes the assertion that no building which it has rodded has ever been struck.

The economic losses due to lightning fires are large. In 1913 there was a loss of more than a million dollars in Illinois from this cause. One farmers' mutual insurance company reports that 85 per cent of the losses of the company for 1913 were caused by lightning. Another reports that every loss of theirs in 1913, with the exception of one, was caused by lightning.

In the state of Minnesota, in 1910, lightning caused 190 fires, entailing a property loss of $248,479. In Iowa, in 1914, 227 fires were caused by lightning, the loss being $402,670. In Indiana, in 1913, the lightning fires numbered 917 and the property loss was $852,103. Of these 917 fires, 718 were buildings not rodded and 14 were upon rodded buildings. In the case of the remaining 185 fires, no information was received as to whether the buildings were rodded or not. In the same state, in 1914, only seven rodded buildings were struck. In these cases it was reported that the rods were in bad shape — not properly grounded, or having been up a long time, or not touching the ground by several feet. In some cases the charge came over the telephone wire.

Buildings having elevated features such as steeples, chimneys, flagpoles, or high peaked and gabled roofs are especially likely to be struck by lightning. The lightning loss is much larger in the country than in the city. In the state of Indiana, in one year, 75 per cent of the lightning fires occurred in the country and 25 per cent in the towns and cities, with a majority of risks in the latter. Barns in the country seem particularly liable to be struck.

It is often said that lightning never strikes twice in the same place, but this is not quite true. The first discharge leaves a column of heated air between the cloud and the earth, and this may become the path of a second discharge, because of lessened resistance. This column of heated air may drift about, and it is believed that the striking of an object below its highest point may be brought about through this means.

Use of Copper in Rods

Copper is a peculiarly good conductor of electricity. It does not corrode in the ground and is therefore better than iron for rodding purposes. But iron has a higher fusing point than copper, which is an advantage. The preferred form of the copper conductor is either tape or stranded cable. The cable is advised because it can be attached more securely. The copper should be pure. It has six times the conductivity of iron and twice the conductivity of aluminum. A flat copper wire conductor is thought to be more effective than a flat copper tape, because of its larger conducting surface. For buildings such as stores, barns, and residences, where the maximum height is not more than 60 feet, copper cable weighing not less than three ounces per foot is suitable. No single wire should be less than .046 inches in diameter.

Construction and Installation of Rods

Conductors should have as few joints as possible, to reduce the danger of a break in the connections. Formerly, conductors were insulated, but this is not generally thought necessary. The cable may be fastened directly to the building, being held in place by clamps. As metal is a much better conductor than wood, brick, or the usual building materials, there is little danger of the lightning leaving the conductor. Sharp bends in the cable should be avoided, straight runs being more effective. The conductors should lead downward. Air terminals should extend at least 18 inches above the point of protection. On large buildings the rods should project higher than this. All exterior metal work should be connected with cables or be separately grounded. Metal roofs should be grounded at two, preferably four, corners.

To be efficient, the lightning rod must be well grounded. This means that the cable should extend into the earth down to permanent moisture. The best way is to extend the cable deep into the earth. It is the practice of reliable companies to guarantee to run the cables down ten feet. Connection may be made with underground metallic water-piping, as in the case of a farm building having a driven well outside. Where the soil does not permit running down the copper cable, a driven pipe or a ground plate properly put down may be used. Every rod should have two ground connections.

It is absolutely essential that the cables should not run near interior metal work or piping. If the conductors are run too near interior piping, the discharge may side flash or jump from the conductors to the pipe and thus start a fire.

A Testimonial

Thomas A. Edison, the great inventor, believes in the lightning rod. Read what he says in the following letter:

From the Laboratory of
THOMAS A. EDISON
ORANGE, N. J., *April* 28, 1915.

Mr. Arland D. Weeks,
North Dakota Agricultural College,
North Dakota.

Dear Sir: —

Replying to your inquiry, I would say that in my opinion a building may be protected from lightning by a properly installed system of continuous conductors of ample capacity, well insulated from the building, provided such conductors (lightning rods) are properly connected to metallic plates of ample size buried in earth which is kept permanently moist. I cannot undertake to prescribe or recommend any particular method or system.

Yours very truly,
THOMAS A. EDISON.
WHM.

Personal Danger from Lightning

The body is a good conductor of electricity because of its moisture content. Lightning is therefore so dangerous to life that a few suggestions are desirable. When electric storms occur it is unwise to stand near tall objects which are poor conductors, because the fluids of the body are a good medium and lightning may leave the poor conductor and pass through the person. It is not dangerous to stand near a well-grounded lightning rod because such a rod is a better conductor than the human body and electricity usually follows the better conductor.

PHOTOGRAPH OF A LIGHTNING FLASH

One should not approach an open window during a thunder storm, because drafts may determine the direction of the discharge, and the iron bolts, bars, and hinges may convey a shock. Keep away from the fireplace during an electric storm, for the metal work is a good conductor, as are also soot, vapor, and smoke; these may conduct charges which may jump to a person's body on their way to the earth.

Thick rugs and hair mattresses, being dry and being non-conductors, insulate the human body and may be utilized for protection. The middle of a room is the safest place because removed from conducting surfaces. The middle story of a house is safer than either the attic or basement. In some cases houses have been struck by electricity from the earth. One should not stand near water, because water is a good conductor and a discharge moving toward the water might pass through a person standing near.

The electricity above a given place on the earth in a storm seeks to reach the earth by the easiest path, somewhat as water tends to break through the weakest part of a dam. Good conductors are like the weak spots in the dam. The electricity rushes through good conductors, or substances of weak resistance. One should avoid positions with reference to objects such that the electricity will use the body as a connecting link in its path to the earth.

The effect of electrical shocks upon the body is to stun, burn, or kill.

Danger to Animals

Many farm animals are killed every year by lightning. A discharge of electricity may leave a trunk of a tree, or a wire fence, and pass through the animal's body as this offers less resistance. To prevent farm animals from being struck by lightning near wire fences, an iron post should be placed every six or eight rods and be driven deep enough into the earth to connect with permanent moisture. Such posts are furnished by dealers.

FOR THE RECITATION

1. What is lightning?
2. Compare air with other substances as a conductor.
3. What are the effects of lightning?
4. Give proof of the efficiency of lightning rods.
5. What is the attitude of insurance companies in regard to rodding?
6. What structures are most liable to be struck?
7. What metal is the best conductor of electricity?
8. Give suggestions for proper rodding.
9. Describe effective grounding.
10. Why should cables not be run near inside metal work?
11. Why are people and animals liable to be struck?
12. How may wire fences be made safe?
13. What is Edison's opinion upon the efficiency of lightning rods?

14. It is suggested that copies of publications dealing with lightning and lightning rods be secured for class use.

Note — The Department of Agriculture, Washington, D. C., has issued a bulletin on lightning rods, as have also some of the federal experiment stations. The National Board of Fire Underwriters, New York, issues a little pamphlet giving rules for rodding buildings. The author, however, has found nothing on the general subject more convincing and practical than Bulletin 220 of the Ontario Department of Agriculture, Toronto, by Professor Day.

XIII

Forest and Prairie Fires

Effect of Forest Fires

A FOREST fire destroys small trees and seedlings and, if it gains sufficient headway, may kill the big trees also. The bark at the base of the tree is heated or baked, thus destroying growth. If the wind is high and other conditions favorable, the fire is carried up through the tops of the trees and an intense heat is produced. The rich accumulation of humus on the forest floor is burned and the ground is left bare. On hillsides and mountain slopes

EROSION OF AN UNPROTECTED SLOPE

erosion then takes place readily, the rains washing away the upper part of the soil or leaving the rocks naked. In severe fires the soil is baked and consumed, the burning not being confined to the richer mold on the surface.

Game is often destroyed in forest fires; and people in farmhouses and in small towns in timbered regions are in danger and often must fight for their lives.

FIGHTING A FOREST FIRE

Causes

It is not easy to put out forest fires when once started. They should be prevented. Sparks from locomotives have caused many such fires, but of late years spark arresters have been used by railroads, and companies have coöperated in keeping down the losses from this cause. Lightning starts forest fires. Hunters and campers sometimes leave their camp fires burning, or are careless in the use of matches, in throwing away cigarette or cigar stubs, or in emptying pipes. Brush-burning on clearings and sparks from sawmill smokestacks are other sources of danger. Occasionally forest fires are of incendiary origin.

A Burned Forest

Where extensive lumbering operations have been going on, the most serious fires are likely to occur. The lumberman leaves the tops, limbs, and branches of trees scattered on the ground. These dry out until they become highly inflammable, especially in a dry season. The fire from the "slashings" may extend into green and standing timber and it is then very difficult to put out.

Extent of Damage

Many of our western states have suffered severely from forest fires. Hundreds of thousands of acres of timberland have been burned. The smoke from burning forests in Michigan, Idaho, and other timbered states often clouds the air and can be distinctly smelled a thousand miles away from the scene of conflagration. California, Washington, Oregon, Minnesota, and Wisconsin have frequently experienced such forest fires. The loss in Wisconsin from forest fires has in certain years reached between five and ten million dollars.

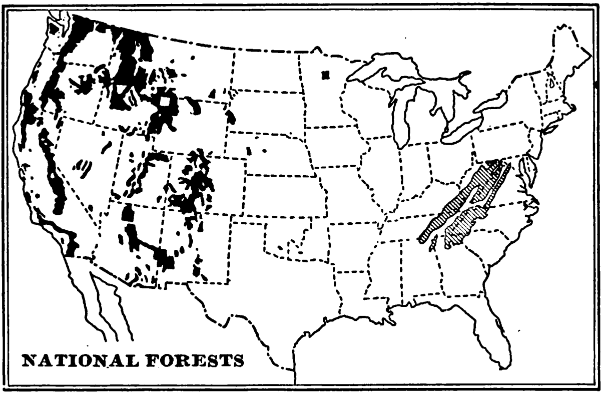
Government Protection

In recent years the federal and various state governments have undertaken systematic forest protection. Patrolmen and groups of workers have been engaged in keeping forest fires within bounds, as well as in preventing their being started. Fire lines are cut, dividing the forest into blocks. Brush-covered lands are cleared up. The telephone is used to communicate between stations, and in Wisconsin 40 to 60-foot steel towers for lookouts are built on high hills throughout the forest reserve. Cabins for rangers are built.

The tools for fighting fire include shovels, axes, wet sacks, hoes, brush hooks, and rakes. Canteens for carrying water and lanterns for night work are required. Sand or earth may be thrown upon a fire instead of water.

The Patrolman

The patrolman has a map showing the principal features of his district and adjoining districts and the location of the routes of federal and state patrolmen. It is his duty to put out small fires and to warn persons against carelessness, recording their names so that fire prevention literature may later be mailed to them.



The black portions indicate the present reserves; the shaded sections in the east show the Appalachian and White Mountain reserves

During wet weather the patrolman is employed in trail clearing, telephone construction, and road making. He has a list of the persons who might help in putting out fires in his territory, and he notifies these persons when a fire breaks out. When from his lookout on the mountain the patrolman sees, perhaps through field glasses, that a fire has started, he telephones lumbermen, watchmen, owners of timberland, other patrolmen, and deputy and chief wardens.

The federal forest service has charge of the protection of nearly 200 national forests, comprising more than two hundred million acres. Many important watersheds are protected by the federal government in coöperation with state governments. Watersheds of rivers in the following states are thus jointly guarded against damage by fire: Maine, New Hampshire, Vermont, Massachusetts, Kentucky, New York, New Jersey, Maryland, Wisconsin, Minnesota, and Oregon.

Prairie Fires

Prairie fires are all too frequent in the Great Plains region. They do damage by burning off the grass of the sheep and cattle ranges and by destroying hay stacks and farm and ranch buildings. Schoolhouses have been burned by prairie fires and towns threatened. Loss of life frequently occurs. Driven by high winds, prairie fires devastate great areas, sometimes spreading over paths twenty miles wide and extending through whole counties.

Farmers and ranchers plough furrows in the path of the prairie fire, thus stopping it if the wind is not too high. Fire-drags made of logs or metal are drawn along, thus smothering the blaze. Sometimes it has been necessary, for lack of another sort of fire-drag, to shoot a steer and to drag the carcass by ropes attached to the saddles of two horses ridden by cowboys.

The prairie fire is the terror of the semi-arid plains region, as it was years ago in the prairie region of the Central West, before the time of intensive farming. In order to protect farm buildings and hay supplies, it is a common practice not only to plough around them but also to back-fire, which means to burn a wide path which itself serves as a barrier to an oncoming fire.

For the Recitation

1. What harm does a forest fire do?
2. What is humus?
3. How do forest fires usually start?
4. What conditions are favorable for forest fires?
5. What are the patrolman's duties?
6. What tools are used in fire fighting?
7. What is a watershed?
8. What damage is done by prairie fires?
9. What methods are used in putting them out?

XIV

Fires Set by Persons

The Pyromaniac

A CONSIDERABLE number of fires are caused intentionally by persons. Of the many fires whose causes are reported as unknown, it is believed that a large proportion are of such origin.

There is the pyromaniac, or "fire bug," — a person who has a strong impulse to set fire to things. Among the feeble-minded and the insane this tendency sometimes appears. Fire is attractive and even somewhat fascinating to us all, and it seems that in some persons interest in fire becomes a mania. Individuals who show an unusual interest in a fire need to be watched. Defectives with this special interest are likely to start fires for the pleasure of seeing buildings burn. The reports of fire marshals make frequent mention of the pyromaniac. The following paragraph from the report of the State Fire Marshal of Iowa, 1915, is typical:

> In the fall of 1914 a number of fires took place at Estherville, the circumstances connected with each of which strongly indicated an incendiary origin. Suspicion was directed to one Vergil Elliott, a sixteen-year-old boy in the town, and this young man finally confessed to having set eight fires. He was

taken before the commissioners of insanity, who found that Elliott was a pyromaniac and recommended that he be taken to the hospital at Cherokee, where he is now confined.

Dr. Ralph Johnson of Girard College, an authority upon feeble-mindedness, cites the case of a fire bug who finally found his niche in society in taking care of a furnace, which satisfied his fire-building impulse.

Another kind of fire bug is the person who sets fire to his own property for the sake of getting the insurance, or commits arson to cover up crime. Insurance companies recognize a moral and a physical hazard. The physical hazard is the risk of property being destroyed by fires originating by accident or by natural causes. The moral hazard is the danger that the insured will want "to sell out to the insurance companies."

Dishonest Property Owners

Cases occur where business men who are overstocked, who have inferior goods, or who are in financial straits set fire to their own property in order to collect the insurance. Out of the 2511 fires in Minnesota in 1913, sixty-four — or about one in forty — were incendiary.

Recently in Indiana the trading section of a village was destroyed with a two hundred thousand dollar loss by a fire due to the desire of the owner of a small shop to profit on shelf-worn and over-insured goods.

In Illinois, confessions by members of arson gangs show that these criminals destroyed hundreds of thousands of dollars' worth of property, and that they openly talked of selling property to insurance companies and solicited business.

Fourteen members of an arson gang in Chicago were convicted and sentenced to the penitentiary at Joliet.

Over-Insurance

Over-insurance is a frequent cause of incendiarism. Fire insurance agents rarely take the trouble to view property before writing policies. An investigator in New York City secured large amounts of insurance upon the "contents" of buildings and apartments which were empty, thus disclosing the lax methods of writing policies. Says Joseph Johnson, Fire Commissioner of New York City:

> The facility with which insurance policies are granted at present affords a strong incentive to the commission of arson. Not only is it quite easy to secure fire insurance on worthless household effects, but unscrupulous agents, with the sole object of making commissions, assiduously canvass every tenement and small business house in a city, attempting to place as many policies as possible.

The Valued Policy

The so-called valued fire insurance policy is an incentive to arson. In this kind of policy the insurance company agrees to pay a certain sum mentioned in the policy if the insured property is fully destroyed by fire. Accordingly, the insured sometimes receives from the insurance company a larger sum than his property is really worth; this tempts dishonest owners of insured property to set fire to it. When the policy is not a valued policy the company pays only what the destroyed property is actually worth.

Laws have been proposed or passed in a number of the states requiring that insurance companies write valued policies. Among the states having such a law are New Hampshire, North Dakota, Missouri, Kansas, Kentucky, and Tennessee. The motive for such laws is the feeling that insurance companies are not always fair in their adjustment of losses. If an insurance company evades the payment of insurance in a tricky manner, or seeks in any way to avoid a just settlement for losses, the public is likely to seek some means of protection.

Fire marshals and commissioners of insurance say that the valued policy increases losses. The western states having the highest rate of loss in 1911 were Kentucky, Kansas, and Missouri. These states have valued policy laws. Their rates of loss were larger than those in adjoining states not having such laws. Valued policy laws tend to increase premium rates, or the cost of insuring property, thus increasing the burden upon honest policy holders. It should be possible to find a better plan than the valued policy for protecting the insured in the settlement with the insurance company. It is a worthy effort on the part of law-makers to try to hold insurance companies to a just settlement of losses, but the valued policy seems not to be the best plan, for this policy offers a motive for burning one's own property.

FOR THE RECITATION

1. What is pyromania?
2. What is arson?
3. What is the physical hazard in insurance?
4. The moral hazard?
5. Look up a recent report of a state fire marshal and see what percentage of fires was known to be of incendiary origin.
6. What is the relation between over-insurance and arson?
7. Ascertain if insurance agents in your locality inspect property before writing policies.
8. What is a valued policy?
9. Name states having valued policy laws.
10. What are the two classes of fire bugs?

XV

Moving Picture Exhibitions

Celluloid

THE moving picture theatre is a place of special fire danger. The pictures are photographed on films of celluloid — a substance which takes fire with a flash and burns rapidly with great heat. Celluloid is made by soaking strips of cotton or tissue paper in nitric acid, a soft mass being made by adding camphor. The material is rolled into sheets and heated under great pressure to make it hard.

Many articles in common use are made of celluloid, such as the backs of mirrors, brush handles, playing cards, baby rattles, eye shades, manicure sets, powder puffs, and collars. In whatever form it is used celluloid is dangerous, but especially so are the moving picture films, because of the large amount of celluloid present and the heat of the lamp used behind the film.

On December 24, 1914, a smoking car on the Burlington Railroad was the scene of an explosion presumably caused by the taking fire of celluloid moving picture films. Two persons were killed and 31 seriously injured in the accident. The interior of the car was burned out. Some railroad companies now prohibit the carrying of films in passenger cars.

Precautions

Every means should be taken to make moving picture theatres safe. Panic has as bad results as are directly caused by fire itself. The metal fireproof booth is now used as a means of protection against the combustible films. The fumes from burning picture films are dangerous, and a person attempting to extinguish the flames of celluloid is liable to be rendered unconscious. The following rules for the safe operation of moving picture theatres are recommended by the State Fire Marshal Department of Illinois.

First — The booth must be of fireproof construction. One fire extinguisher must be kept inside each booth.

Second — The entrance door to the booth must open outwardly, arranged with automatic self-closing fire door, closed by means of metal rope and weight attachment, or some other equally satisfactory device. Door should be closed when machine is in operation.

Third — Look-out and lens openings shall be protected by gravity doors of fireproof construction, over-lapping all sides of openings at least one inch, and to be held open by fine cords which are easily combustible. These are the only openings permitted on the sides exposed to the auditorium.

Fourth — Each booth shall have a flue at least 12 inches in diameter to carry off the hot air generated by the machine. Note: Many cities require an electrically driven exhaust fan to carry off this foul air.

Fifth — Machine must be kept in first-class condition and must be equipped with a fireproof magazine for top reel and tension take-up device with fireproof magazine for bottom reel; also automatic shutter and shields which adequately protect and cover the films between the magazines.

Sixth — Never permit a film to run on the floor. If the take-up fails to work, stop the machine and fix it.

Seventh — Never rewind one film while showing another. Operator should never read while showing a picture or rewinding a reel.

Eighth — Look over your films before showing them in public. If the sprocket holes are torn, mend the film. If the film is in bad condition do not use it.

Ninth — Keep all extra films in metal boxes at all times, at least two feet away from the machine.

Tenth — Smoking or carrying of matches shall be positively prohibited in all booths either during a performance or at any other time.

Eleventh — Never permit boys to operate the machine or to rewind the films, and do not allow any one in the booth except the operator.

Twelfth — Display for at least sixty seconds before each show a slide directing attention to the exits and the use, in emergency, of the one nearest the seat occupied.

Thirteenth — No audience of a greater number than the seating capacity of the auditorium shall be permitted in the auditorium during the operation of any motion picture machine, and no one other than employes of the theater shall be permitted to stand in the aisles. All aisles leading to exits shall be kept open and free of any obstruction and all doors shall open outward.

Fourteenth — The main auditorium shall have no perpendicular rises and the grade of any incline shall not be more than one foot in ten.

Fifteenth — All motion picture exhibition rooms shall be provided with at least two separate exits, one of which shall be in the front and the other in the rear, both leading to unobstructed outlets in the street or alley. (Note: Side exits easily accessible may be installed in place of rear exits.) The aggregate width in feet of the exits should not be less than one-twentieth of the number of persons afforded seating capacity in the theater, and no exit should be less than five feet in width and the main exit should be at least ten feet in width.

Sixteenth — All seats in any exhibition room for moving picture machines shall be not less than thirty-two inches from back to back and shall be securely fastened to the floor. The seats shall be so arranged that there will not be more than ten seats in a line between aisles nor more than four seats between any seat and an aisle.

Seventeenth — All exit doors shall be arranged to swing outward and be provided with fasteners such as can be readily opened from the inside without any keys or special effort, and shall *never be locked or fastened when the room is open to the public.* All exits shall be plainly indicated by an illuminated sign and bear the word "Exit" in red letters which shall not be less than four inches in height, and where electricity is used for the illumination of these signs the current shall be on a separate supply from other parts of the house.

Eighteenth — In the event of fire do all you can to prevent a panic in the audience.

FOR THE RECITATION

1. What is celluloid?

2. Ignite a small piece of celluloid. Observe the character of the flame and the fumes.

3. Write a list of fifteen articles made of celluloid.

4. Procure, if possible, a piece of a motion picture film. Ignite it.

5. Are the motion picture houses in your town officially inspected?

6. Report upon the seating and exits of some motion picture theatre.

7. Talk with a motion picture operator in regard to precautions taken, having in mind the Illinois rules.

8. Let the class discuss these rules one by one.

XVI

The Causes of Fire

BELOW is reprinted a table from the report of the State Fire Marshal of Iowa for the year ending December 31, 1914. The table is of interest as it shows the number of fires in one year due to various causes and the amount of damage resulting. Not all the causes of fire are found in this table, but one may profit by reading it carefully. The causes which produce the greatest number of fires should be noted, such as children and matches, defective flues, gasoline, spontaneous combustion, lightning, etc. A large number of causes are unknown. It is believed that among these spontaneous combustion is often the real cause. Iowa is a state of two and a quarter million population, somewhat evenly divided between town and country. Conditions in many other states would not be very different from those in Iowa, and the causes of fires here listed correspond closely to those given in reports from other states.

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Acetylene explosion	1	$ 3,200
Adjoining fires	451	916,150
Ashes against wood	31	8,778

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Ashes in basement	4	$ 5,102
Automobile or motorcycle backfire	42	24,136
Blacksmith forge	2	325
Blow torch	10	1,654
Boiling varnish on stove	1	50
Bonfires	20	10,312
Breaking of gasoline feed pipe on auto	1	200
Burning brush and leaves	2	142
Burning insects in hen house	7	2,310
Burning manure near barn	1	1,995
Burning meadows or grass	5	1,065
Burning rubbish	27	11,777
Candle carelessness	4	180
Candy boiling over	1	35
Chemical explosion	1	1,000
Children and matches	139	54,427
Children playing with electric car	1	150
Children playing with fire	2	175
Chimney through haymow	1	1,500
Christmas trees and decorations	6	1,960
Cloth around steam pipe	1	125
Clothing against chimney	1	1,515
Clothing or rags near stove or stovepipe	26	15,529
Coffee urn in restaurant	3	3,500
Curtains blowing into flame	8	1,928
Defective alcohol container	1	610
Defective boiler	1	950
Defective fireplace	13	870
Defective flue	375	370,648
Defective furnace	20	75,590
Defective gas stove	3	59

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Defective gasoline lighting system	10	$ 29,698
Defective hot air pipes	4	2,870
Defective oil or gasoline stoves	18	8,799
Defective oven in bakery	2	150
Defective stove	14	12,800
Defective stovepipe	14	12,233
Defective electric wiring	60	218,112
Electric iron carelessness	4	927
Explosion in combustion chamber	1	15,000
Explosion in engine cab	1	4,071
Explosion of kerosene can	3	3,350
Explosion of oil tank	1	10
Explosion of solder	1	450
Fireworks	21	4,119
Flashlight powder	2	30
Friction of machinery	3	825
Fumigation	3	3,218
Furnace explosion	3	2,610
Furnace or pipes too near wood	11	4,360
Gas explosion	2	2,747
Gas or gasoline jet flame	7	1,467
Gas leak	8	7,584
Gasoline carelessness	7	875
Gasoline — cleaning with	18	20,006
Gasoline engine backfire	6	10,540
Gasoline explosion	23	10,966
Gasoline iron explosion	1	100
Gasoline lamp explosion	2	3,247
Gasoline leak	3	40
Gasoline or oil stove explosion	68	42,548
Grease on stove	4	244

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Heating oil	3	$ 4,055
Heating paint on stove	2	677
Hot box	4	7,058
Incendiary and probably incendiary	120	147,643
Incubator	3	4,655
Jack-o'-lantern	1	8
Kerosene jug near furnace	1	5
Kettle of tallow	1	50
Kindling or wood near stove	5	1,734
Lamp or lantern carelessness	17	11,328
Lamp or lantern explosion	29	15,312
Lamp or lantern upset	12	3,916
Lard rendering	1	42
Lightning	271	403,633
Live coal carelessness	8	1,873
Live wire on roof	1	291
Looking for gasoline leak with light	1	8,200
Match carelessness	78	19,460
Matches ignited by sun	2	450
Motion picture films	10	7,659
Oil in bucket on stove	1	3,000
Oily rag carelessness	15	10,933
Oil or gasoline stove carelessness	19	2,841
Oil stove near bed	2	300
Oil stove overturned	1	175
Overheated boiler	1	150
Overheated blast furnace	1	50
Overheated cupola	1	2,900
Overheated electric warming plate	1	125
Overheated engine	1	25
Overheated feed cooker	2	766

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Overheated flue	5	$ 1,780
Overheated furnace	21	25,483
Overheated gas heater	1	430
Overheated hot air pipes	6	8,497
Overheated kiln	2	450
Overheated motor	2	5,755
Overheated oat dryer	1	2,500
Overheated oven in bakery	2	120
Overheated peanut roaster	2	2,530
Overheated seed sprouter	1	10
Overheated shafting and bearings	2	12,025
Overheated stove	64	45,933
Overheated stovepipe	24	5,540
Overheated washing machine in laundry	1	200
Paper balloon	2	772
Prairie fire	1	150
Rags or paper in flue hole	6	162
Roofing cement on stove	1	25
Rubbish in air shaft	1	50
Rubbish in or near building	16	6,364
Rubbish near stove or furnace	7	4,820
Smoker's carelessness	69	61,772
Smoke house fires	5	2,640
Slacked lime	2	650
Soldering on roof	1	5,075
Sparks from boiler	1	400
Sparks from cupola	1	350
Sparks from feed grinder	1	25
Sparks from fireplace	1	10,000
Sparks from flue	527	200,624
Sparks from gasoline engine	4	2,677

Origin	*Number of Fires*	*Damage to Buildings and Contents*
Sparks from locomotive	66	$ 56,185
Sparks from machinery	5	3,010
Sparks from steam roller	2	135
Sparks from stove	5	2,734
Sparks from traction engine	7	18,919
Sparrow's nest near chimney	1	4,843
Spontaneous combustion	131	261,045
Starting fire with coal oil	7	5,310
Starting fire with gasoline instead of coal oil	5	1,005
Stove blow out	11	18,337
Stove too near bed	2	425
Stove too near unprotected wood	40	8,074
Stove upset	3	85
Stovepipe through wall or ceiling	25	10,416
Stovepipe too near ceiling or woodwork	13	1,845
Supposed mice and matches	13	28,257
Tailor's iron carelessness	4	1,550
Tar pot boiling over	3	630
Thawing frozen water pipes	22	61,783
Tornado overturning house	1	3,100
Train wreck	2	5,250
Tramps	10	23,849
Unknown	969	2,307,471
Vulcanizing machine	15	25,327
Wood near hot iron in foundry	1	15
X-Ray machine	1	337
Total	4,296	$5,858,985

For the Recitation

1. Give any causes of fire not appearing in the table.

2. Find the total number of fires due to gasoline, to sparks, and to lamps.

3. List in order the ten causes producing the greatest number of fires.

4. List in order the ten causes resulting in the greatest damage.

5. If there is a state fire marshal in your state, secure his report and compare causes and frequency of fires.

XVII

Putting Out Fires

WATER is good for putting out fires because it will not itself burn and because it absorbs a great amount of heat, thus lowering the temperature of burning materials below the kindling point. No substance in the world, except the gas hydrogen, requires so much heat per pound to raise its temperature one degree as does water. You have noticed how long it takes to heat a kettle of water.

Water can come into contact with all the outer portions of a burning object and thus not only rapidly lowers the temperature through its great absorption of heat but also cuts off the supply of air. A large amount of heat is required also in the process of changing water into steam, so at all times the water is taking away heat when thrown upon a fire.

Water, therefore, is the best general agent in extinguishing fire; but any means by which the air may be kept from the blaze will serve. When a person's clothing is on fire, he should be rolled in a blanket or rug, as this cuts off the supply of air from the fire. Carbonic acid gas also has a smothering effect upon flames and is used as a fire extinguisher.

Apparatus

Every residence and place of business should be equipped with simple fire-fighting apparatus. A good garden hose of sufficient length to throw a stream upon the roof should be kept at a convenient place winter and summer, wherever water pressure is available. A good ladder is a necessity. Pails are usually at hand, but in many kinds of buildings fire pails should be placed at convenient points.

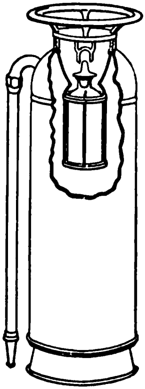
The Hand Grenade

Firemen sometimes use hand grenades. The hand grenade, which is a glass bottle holding a non-freezing liquid, contains a chemical which upon contact with fire produces a fire-extinguishing gas: The bottle is tightly sealed to guard against evaporation.

HAND GRENADE

The Chemical Extinguisher

Carbonic acid gas fire extinguishers are in common use. These cost from $8 to $20. They are metal tanks or cylinders of several gallons capacity. These extinguishers are fastened to walls or placed on supports in corridors and at other convenient points. When used, the cylinder is inverted and the contents directed upon the fire through a hose attached to the top of the extinguisher. By the inversion of the cylinder the seal of a bottle on the inside is broken and the sulphuric acid which it contains passes into a solution of bicarbonate of soda in the tank. Carbonic acid gas is thus formed, giving sufficient pressure to throw a stream of the chemical water about fifty feet. The fire is most readily smothered with the solution when thrown upon it from above, the gas formed being heavier than air. The fire extinguisher may be refilled and used many times; it must be refilled at least once a year.



SECTIONAL VIEW OF PORTABLE CHEMICAL EXTINGUISHER

The cylinder of this extinguisher is often made of copper and is constructed to withstand heavy pressure, one make being tested to stand a pressure of 350 pounds per square inch. The lead stopper in the bottle of sulphuric acid is arranged to act as a throttle when the tank is inverted, thus controlling the flow of acid and preventing the mixing of all the acid at once, thereby avoiding the danger of too high pressure.

Only those makes of fire extinguishers which have been approved by the National Board of Fire Underwriters or the National Fire Protection Association should be used. The Iroquois Theatre fire in Chicago, a fire which destroyed the lives of more than 600 people, could have been extinguished at the beginning had it not been for the fact that the fire extinguisher used was worthless, there being merely a few cents' worth of soda mixed with water in the container.

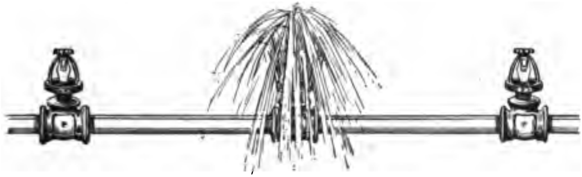
The Fire Tube

Another kind of extinguisher is the fire tube, a cylinder about twenty inches long and two inches in diameter, containing a chemical composition in the form of powder. In case of fire the lid is jerked off and the contents thrown upon the blaze. The tubes are placed at convenient points, as in the corridors of hotels and other buildings. The fire tube is useful in putting out fires just starting, especially oil fires.

FIRE TUBE

The Automatic Sprinkler

Mercantile and manufacturing buildings are often equipped with automatic sprinklers. The head of the sprinkler has a metal cap whose seal is automatically broken when the temperature reaches 160 degrees Fahrenheit. Under pressure, water is then thrown out covering an area of about 100 square feet. A number of heads are necessary to cover a large room. The heads would operate, of course, where the heat was greatest, or, in other words, where the water was most needed. Lower rates are granted by insurance companies when property is protected by automatic sprinklers, as the sprinklers act at the very beginning of a fire and thus prevent its spreading. When the sprinkler opens a fire alarm is automatically sounded.



AUTOMATIC SPRINKLER

The Automatic Alarm

The automatic alarm is used in mercantile buildings and in factories. This alarm is a device which gives the alarm of fire when the temperature of a room reaches a certain point, usually 150 degrees Fahrenheit. The wiring is installed after the manner of telephone wires, and connections are made with the city fire department. In this device copper tubing of a small size is run along the ceiling or walls of a room. The tubing being filled with air, when a room becomes over-heated the air in the tube expands and causes a pressure which, operating upon the automatic alarm machine, sends in a warning. Even where watchmen are employed the automatic alarm is of great value, as it may disclose a fire before it is discovered by the watchman.

For the Recitation

1. Why is water a good extinguisher of fire?

2. Name pieces of simple fire-fighting apparatus.

3. Explain the use of the hand grenade.

4. Explain the construction and use of the carbonic acid gas fire extinguisher.

5. What is the automatic sprinkler?

6. Describe the automatic alarm.

7. What is the fire tube?

8. Devise a laboratory experiment to show that the gas formed by combining sulphuric acid and soda puts out a blaze.

9. Try a fire extinguisher and refill according to directions on the tank.

10. How often should the chemical fire extinguisher be refilled?

XVIII

Agencies of Fire Prevention

It is estimated by the State Insurance Board of Texas that eighty per cent of the fire loss is preventable by the exercise of reasonable care. The State Fire Marshal of Kentucky thinks that sixty per cent of fires can be prevented by proper precautions. Other authorities believe the number of preventable fires to be fifty per cent of the total. It is evident that the exercise of ordinary caution would greatly reduce the destruction of property by fire.

The State Fire Marshal

Public opinion is being aroused to the needless waste by fire, and steps are being taken toward organized prevention. Within the past few years many of the states have created the office of fire marshal. The duties of the state fire marshal, as defined in the State Fire Marshal Law of Indiana, 1913, are to enforce all laws of the state and ordinances of cities and towns applying to (1) the prevention of fires; (2) the storage, sale, and use of combustibles and explosives; (3) the installation and maintenance of automatic or other fire alarm systems and fire extinguishers; (4) the suppression of arson and the investigation of the cause, origin, and circumstances of every fire. Massachusetts was the first state to enact a fire marshal law, for the purpose of putting a stop to incendiarism.

The states having laws creating the office of fire marshal or fire commissioner are: Alabama, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, and Wisconsin. The District of Columbia also has a fire marshal. The State Fire Marshal Law of New York was repealed in 1915.

Value of Reports

The state fire marshals in the thirty states in which they exist are doing notable service in lessening fire waste. The reports of these officials contain information of the most valuable character and should be read by the general public and placed on file in schools. Tables showing causes and amounts of fire losses are prepared by the marshals and many practical suggestions are offered for the avoidance of fires. Cases of incendiarism are described and the outcome of court proceedings given. The work done by inspectors is reported and comments are made looking toward a fuller educational work. In

Illinois and Wisconsin and other states press bulletins are sent out regularly to the newspapers.

School Instruction

In some states the teaching of fire prevention in the schools is required by law. Fire drills are general among the states, but specific instruction in fire protection is required in comparatively few. In 1915 the only states in which the law required the teaching of fire prevention in the schools were Kansas, Montana, Nebraska, Ohio, Oregon, Iowa, and Pennsylvania, only seven out of 48. It should be said, however, that in some of the states not having laws for the teaching of fire prevention, instruction of this kind is to a certain extent given through the initiative of school authorities or upon fire prevention days designated by the governor. In Wisconsin, Arbor Day has been made also Fire Prevention Day by proclamation of the governor. The governor of Iowa each year designates a fire prevention day for observance in the schools.

Educating the Public

Educational work along this line may be very effectively carried on by the state fire marshal. The marshal is in a position to educate the public in a general knowledge of methods of preventing fire waste. A good deal of instruction may be afforded by example. The inspection of buildings makes it clear that there is such a thing as fire prevention, and when a dilapidated structure is condemned by the fire marshal and ordered destroyed, an object lesson is afforded. The methods used in the educational campaign carried on in Indiana through the fire marshal's department are most interesting and suggestive. They are described in part as follows:

When a report of fire is received, the man sustaining the loss is sent a leaflet on fire prevention containing special reference to the cause of his loss. This leaflet calls attention to the ways of preventing fires from such a cause.

So many calls were received for the information on danger from lightning as given in the marshal's first annual report, that this information was issued in leaflet form and 15,000 copies were distributed among the farmers of the state, principally by local mutual fire insurance companies.

The rules and regulations governing special hazards were distributed over the state, especially at the meetings of the State Fire Prevention Association.

Letters urging special care on the 4th of July were sent to the fire chiefs of the state and to the heads of police departments in the larger cities. To each mayor and each city councilman in Indiana were sent copies of a model ordinance governing the use of fireworks.

Articles on fire prevention were provided for publication in educational and farmers' journals.

A newspaper bulletin service was provided.

Talks on fire prevention were given before farmers' mutual insurance companies, commercial clubs, the State Convention of the Indiana Federation of Women's Clubs, and to many of the high school pupils.

A fire prevention film was shown in several cities.

A fire prevention exhibit was shown at the state fair. This exhibit included a defective flue, a model flue, signs, and placards. Pictures of fires and fire preventive devices, asbestos shingles, and underground tanks for the storage of gasoline were shown.

One of the most important agencies in organized fire prevention is the National Fire Protection Association, Boston. This organization has been in existence about twenty years. It issues many publications, some of which are free and others sold at a small price. It has two functions: one is to establish standards and the other is to educate the public. Standards are fixed applying to explosives, oils, gases, electric wiring, and fire appliances. A quarterly magazine is published containing special articles on fire hazards, fire waste, and prevention. Important fires occurring in the United States and Canada are described, and the manner of extinguishing them is discussed. Special studies are made of the effects of fire upon buildings of concrete or of other fire-resisting materials.

The membership of the association is composed of engineers, builders, architects, merchants, manufacturers, warehouse men, electricians, credit men, bankers, insurance agents and inspectors, fire marshals, fire wardens, fire chiefs, boards of trade, chambers of commerce, public libraries, and other organizations, individuals, and corporations. The many state fire protection associations of the United States are active members of the national organization.

Organized Efforts toward Fire Prevention

An important organization in the field of fire prevention is the National Board of Fire Underwriters, New York. The chief purposes of this organization are the suppression of incendiarism and arson, and the securing of the adoption of improved and safe methods of building construction and of fire protective measures. The membership is made up of fire insurance companies, the leading fire insurance companies in the United States being found on its roll of members. Among its standing committees are those on incendiarism and arson; the statistics and origins of fires; fire prevention; lighting, heating, and engineering standards; and the construction of buildings.

During the year 1914 two important pieces of work were accomplished by this organization. One was the completion and distribution of a suggested building ordinance for small towns and villages.

Another was a revision of the model building code previously published.

The National Board of Fire Underwriters provides the chief financial support of the Underwriters' Laboratories Corporation, chartered November, 1901, by the state of Illinois, "to establish and maintain laboratories for the examination and testing of appliances and devices and to enter into contracts with the owners and manufacturers of such appliances and devices respecting the recommendation thereof to insurance organizations." The principal offices and testing stations are located in Chicago. There are branch offices in seventy-nine cities of the United States, Canada, and England. A label service for certifying the quality of approved wares is carried on. Over forty million labels are provided annually.

FOR THE RECITATION

1. Quote views as to the extent of preventable fire losses.
2. What are the duties of a state fire marshal?
3. In how many states does this office exist?
4. What do the reports of fire marshals usually contain?
5. What states require the teaching of fire prevention in the schools?
6. Describe the educational work carried on by the state fire marshal of Indiana.
7. What are the functions of the National Fire Protection Association?
8. Who comprise its membership?
9. What are the aims of the National Board of Fire Underwriters?

10. What is the membership?

11. Describe the work of the Underwriters' Laboratories.

12. Secure a list of the publications of the National Fire Protection Association.

13. If there is a chemical fire extinguisher in your school building, see if it is labeled by the Underwriters' Laboratories, Inc.

UNIV. OF
CALIFORNIA

FIGHTING A FIRE WITH ENGINES AND WATER TOWER

XIX

Fire Departments in Cities

The Bucket Brigade

A SIMPLE means of fighting fire is the "bucket brigade," but fortunately most of us are now protected by a more efficient kind of fire department than this.

The Volunteer Fire Department

In villages and small towns the fire department is made up of volunteers, who leave their regular work whenever a fire breaks out. In the larger towns and cities a paid fire department is maintained. The men sleep at the fire station and are ready at a moment's notice to rush to the scene of fire.

The Well-equipped Station

A well-equipped fire station is an interesting place to visit. One sees the shining brass pole by which the firemen slide down from their quarters above the first floor. Harnesses are suspended so that the well-trained fire horses may take their places beside the pole of the fire engine and be harnessed without a moment's loss of time. There are hose carts, each carrying hundreds of feet of hose, and there are hook and ladder trucks. Motors have taken the place of horses in many fire departments.

An important feature of the equipment is the steam fire engine. Few cities have water systems which provide pressure sufficient for extinguishing fires. A pump is necessary to force the water to the upper parts of buildings. The hand pump was at one time in use, but power pumps or fire engines have taken their place.

A MODERN FIRE ENGINE

Chemical extinguishers and chemical engines are especially useful in fighting fires before they have gained much headway. The composition of the charge in the chemical engine is the same as in the chemical fire extinguisher described in Chapter xvii.

At every engine house there should be a tower for drying hose. Unless cleaned and dried after use, hose which should last from eight to ten years may be ruined in less than one year. In fighting fires in tall buildings, the use of the hose is made more effective by employing the water tower, by means of which the nozzle may be raised to a considerable height.

Chemical Fire Engine

The City Fire Department

The city fire department consists of a chief, a first and second assistant chief, a captain for the hook and ladder company, a captain for each hose company, and an assistant or lieutenant for each captain. The companies are equipped with fire coats, fire hats, and belts. The smoke helmet is worn when entering buildings where there is danger of suffocation from smoke.

For fighting the fires which frequently occur along the docks upon lake and river fronts, the fire boat gives efficient service.

For the saving of life, nets into which people may jump are used. Hose connections are provided at different heights upon some fire escapes, thus greatly aiding the firemen in subduing fires on the various floors. In such cases the fire escape supports consist in part of water pipes.

Fire Alarm System

The fire alarm system is called the nerve center of the city fire department. Fire alarm boxes are placed on the streets so that anyone who discovers a fire may ring up the department. A common type of fire alarm box is operated by breaking a small pane of glass and pulling the hook. This causes the number of the box to be automatically sounded, and the fire department is thus informed as to the location of the fire.

Everyone should learn the location of the fire alarm box nearest his home and school, or place of business, and pupils should be taught how to turn in an alarm of fire.

The telephone offers a quick and effective way of notifying the fire department. Often this is the better method. Everyone should know the telephone number of the fire department.

Preventive Work by the Fire Department

A larger use might be made of the city fire department as a means of preventing fires. The best time to fight fire is before it starts. Heretofore, little money has been spent upon prevention, the larger amount being spent upon the maintenance of engine houses and fire stations, fire-fighting apparatus and salaries. Firemen are now being employed in the large cities to inspect business and residence districts, instead of sitting around at the fire station waiting for something to happen. They are thus profitably employed in protective work. The laws often require that the chief of the city department coöperate with the state fire marshal in inspection work. A field of great usefulness is open to firemen in discovering fire hazards and in bringing about better conditions. Firemen should be selected with a view to rendering this kind of service. Every city should adopt an ordinance providing for inspection work by the fire department.

To make the work of the city fire department effective, authority must be found for condemning and destroying dilapidated buildings which increase the fire hazard. Illinois has a law providing that cities and villages may pass ordinances for the condemnation of buildings within the fire limits, if these buildings have been damaged by fire or decay to the extent of fifty per cent. In other states the work of the fire marshal involves the condemnation and destruction of dilapidated buildings in certain locations.

Responsibility of Individuals

Greater interest would be taken in fire prevention if the owners of dilapidated buildings and other persons contributing to the origin of fires were held responsible for the results of their negligence. The State Fire Marshal of Illinois proposes the enactment of a law which should hold responsible anyone through whose negligence a fire originates. In New York City the expense of fighting a fire caused by culpable and willful negligence may be collected from the party guilty of the negligence. There is no more reason for excusing a person whose negligence causes a fire than for excusing a person whose negligence causes a runaway or a railroad accident. If persons whose negligence gives rise to fires had to pay the cost, there would be much more care in preventing fire. If a man knew that he would have to pay for any loss caused to his neighbor's property if a bonfire got beyond bounds, he would be remarkably interested in seeing that the bonfire was properly watched.

Civic Interest

Every good citizen should see to it that the fire-fighting organization in the town in which he lives has sufficient water and apparatus and is working along intelligent lines. Conditions are far from satisfactory in many towns and cities. A recent report of the State Fire Marshal of New York lists cities and towns where the means for extinguishing fires are not sufficient. Some of the items are as follows:

Adams, Jefferson County. — Insufficient water and apparatus.

Brockport, Monroe County. — Lack of water. Inability to play a stream for more than twenty minutes.

Campbell, Steuben County. — Village without fire protection; ladder and bucket brigade formed.

Eaton, Madison County. — Lack of water. All available water at the County Home building fire obtained through a small pipe in a barrel; two or three strokes of the engine would empty the barrel and the men would have to wait for it to fill.

Ferndale, Sullivan County. — No water power, no hose. Bucket brigade formed and 1,500 men standing helplessly by at a fire on June 19, 1913.

Middletown, Orange County. — At fire of Children's Home on Houston Heights one line of hose threw a stream of water fifteen feet in the air without the use of the steamer, and one line attached to the steamer threw a thin stream sixty feet — like a spray rather than a stream. With two lines attached to steamer, streams were thrown twenty feet and water coming in jerks from the nozzles caused the steamers to suck the pipes empty, showing insufficient supply of water at that time.

FOR THE RECITATION

1. What is a bucket brigade?
2. What is a volunteer fire department?
3. What is the use of the fire engine?
4. What is a water tower?
5. Describe the organization of a city fire department.
6. What is a fire boat?
7. How may fire alarms be given?
8. Where is your nearest fire alarm box?
9. What is the telephone number of your fire department?
10. What prevention work may be done by firemen?
11. State the Illinois law in regard to the condemnation of dilapidated buildings.
12. Should persons whose negligence causes fires be held responsible? Discuss.
13. What deficiencies in fire protection were shown in certain places in New York?

XX

Fire Drills in Schools

Their Value

FIRE drills in the schools are required by law in many states, and should be a feature of every town and city school system. These drills are important to prevent loss of life from crowding in the excitement of getting to a place of safety. The cry of fire should not throw a school into confusion. Pupils should be trained to know how to act when the fire call sounds or when some one cries "Fire!"

Instruction should be given regarding the location of fire extinguishers and fire escapes. Teachers should understand that it is better to hold their pupils in the classrooms in a time of danger than to let them rush into the halls.

Construction of Buildings

Buildings should be so constructed that loss of life would be unlikely even in a panic. Laws now often require that all doors on public buildings, including schools, be placed to swing outward. The horizontal bar which opens the door by downward pressure is a valuable improvement. Some fastenings make it difficult to open doors quickly in case of a panic.

Fire Escapes

Fire escapes upon school buildings are now generally required by law. These are of two types. A common form consists of iron ladders attached to the outside of a building, with platforms at every story. These may become covered with snow and ice in winter and are in other respects not free from danger.

Another type consists of a spiral slide inclosed in a metal cylinder. There are openings into it at each floor, and the slide is so inclined that the passenger is kept away from the centre and carried to the outer edge near the side of the cylinder, which acts as a brake, preventing a too rapid descent. The passenger descends from top to bottom at a uniform rate of speed and leaves the cylinder in a sitting position, arriving on his feet. Five hundred children have passed through the spiral fire escape from the second and third floors of a school building in about two minutes.

Frequency of Drills

Fire drills should be held often enough to familiarize pupils with the best way of getting out of the building in case of fire. Once a month is recommended. It is well to have the march proceed either by music or by the class bell.

The following excellent rules and regulations for

Fire Drill at School

fire drills are those prescribed for use in the schools of Indiana.

1. Fire drills are practiced that panics may be averted and the children *Marched Out* rapidly and *Without Confusion.*

2. Fire drills should aim at a quick dismissal without going for coats or hats.

3. Fire drills should be had frequently, but at irregular and secret times.

4. See that all exits open outward.

5. See that the exit facilities are sufficient and unobstructed.

6. Keep the fire escapes free from obstruction, ice, and snow. Sprinkle with ashes and sand when slick.

7. Use the fire escapes frequently, both for regular dismissals and for fire drills.

8. Observe the fire drill rules so far as practicable in the regular dismissals.

9. Use a special bell for drill signals. Be sure the signal is *Distinctive.*

10. At the sound of the fire signals, all work must cease instantly. Pupils will rise and march as directed, boys leading.

11. Teachers should follow, to be sure that no child has been left behind.

12. Boys should lead and girls follow, or, if possible, separate exits should be taken. Boys often trample girls in a rush and girls are sure to be frightened at boys coming down behind them.

13. The movement of the children shall be by the shortest route and there shall be no crossing of lines.

14. Classes near the stairway shall precede those further away; lower floor classes shall precede upper floor classes.

15. Fire drills should conclude with the continued march of the children out and away from the school in different directions.

FOR THE RECITATION

1. Why have fire drills in schools?

2. Describe two kinds of fire escapes.

3. How should the doors of public buildings open? Why?

4. What recent improvement has been made in door fastenings?

5. In view of the fact that smoke and flames issue from windows, what would you suggest regarding the placing of fire escapes?

6. Why should pupils not go for coats and hats in a fire drill?

7. What should be the practice regarding announcements in advance of the time of fire drills?

8. Give reasons for a monthly drill.

9. What care should be given fire escapes?

10. In what order should pupils march out?

11. Why should the teachers follow?

12. What objection is there to the crossing of lines?

13. What should be the order of the classes from the upper and the lower floors?

14. Why should the march be continued outside of the building?

15. Find out if the law in your state requires fire drills.

16. Have a committee of students inspect the school building for fire hazards.

17. Have a clean-up day. In some school buildings the conditions are almost ideal for a fire, — basement rooms often being littered with rubbish that is combustible.

18. Inspect the exits of your school building.

XXI

A Number of Suggestions

USE safety matches.

Non-safety matches should be kept in metal boxes.

Do not throw matches into the waste paper basket.

Metal waste paper baskets are better than wooden or reed ones.

Smokers should be careful with matches and with cigar and cigarette stubs. The latter burn a long time.

Chimneys should be built from the ground up; not placed on brackets or other supports.

Bricks are better than cement blocks for chimney construction, as the blocks disintegrate under high temperature.

Clean chimneys, stoves, and stovepipes once or twice a year.

Beware of stoves with cracks in them.

Coal when heated expands and may overflow the fire-box and cause a fire.

Overheated kindlings in the oven may start a blaze.

Ashes should not be placed in barrels or wooden boxes. Be careful with ashes until the heat is out of them.

The strong draft of wood stoves occasionally sucks in light clothing, especially women's dresses, and causes accidents. A number of deaths from burning are due to this cause. A woman counting money lost a bill through its being sucked in by the strong draft of a sheet iron wood stove.

For the fireplace use a closely woven fire fender.

Benzine stove polishes are to be avoided as the benzine is liable to explode if the polish is used upon a heated stove. Manufacturers of non-benzine polishes often direct that their polishes be used on stoves when warm. Do not have a benzine polish in the house. Be sure to call for a fireproof stove polish whether in powder, paste, or liquid form.

Never hang towels or clothing directly over stoves, especially over gas stoves.

Flannelette clothing is quickly ignited, especially before being washed. A non-inflammable kind is on the market and costs but little more. Cotton treated with certain chemicals is made fireproof.

Fire may be extinguished by shutting off air. This is why rolling in a blanket should be resorted to when one's clothing is on fire.

Fill lamps only by daylight.

The wick of a lamp should fit the tube. Do not use a small wick in a large burner.

Lamps turned low are liable to explode.

Paper shades are unsafe on lamps or on electric bulbs.

Movable gas fixtures with unprotected lights are dangerous.

An outside gas shutoff should be provided so that the gas may be controlled from without the building.

Gasoline and kerosene should be kept out of doors.

Underground storage of gasoline in quantities is advised.

When cleaning clothing with gasoline, go out of doors. After clothing has been thus cleaned do not hang it near a fire.

Gasoline and kerosene fires may be extinguished with flour.

Hot iron should be kept away from combustible materials. A fire was started by a heated bolt which a workman left in his blouse.

Electric irons may set fire to the ironing board and to the house.

When the air is thick with combustible dust an explosion may occur.

Destroy rags saturated with oil.

There is much danger in having rubbish about. Attics, basements, and closets should be kept thoroughly clean.

An electric flashlight is safer than matches when one is hunting for things in a closet or dark attic.

Do not build bonfires on windy days and do not start them near buildings.

Keep the children away from bonfires.

Before using wood shingles on a roof, investigate roof coverings made of fire-resisting material.

When lightning rods are being installed, make sure that they are placed deep in the earth and are not "scamped."

Metal lathing is preferable to wooden lathing. A fire burning in partitions constructed with wooden lathing is put out with great difficulty. Firemen often have to chop into partitions and that practically ruins a house. Metal lathing costs little more.

Provide a good ladder for your home.

Keep away from drop fire doors in public buildings. Fatal accidents have happened by their unintentional falling.

In a burning building the best air is nearest the floor, as smoke and flames move upward. Children have been relatively uninjured while older people were suffocated.

Be sure to know the location of the nearest fire alarm box and the telephone number of the fire department.

Textbooks on hygiene contain directions for the treatment of burns.

If the law does not require the teaching of fire prevention, school boards should see that the subject is presented.

FOR THE RECITATION

1. Why should gasoline not be thrown into drains?
2. Why is benzine stove polish dangerous?
3. Find out if fireproof textiles can be bought at the local stores.
4. What is the objection to wooden lathing?
5. What accidents may happen due to a strong draft in the stove?
6. Why should stoves not be filled full of coal?
7. Where can you find directions for the medical treatment of burns?
8. What may be used to put out an oil fire?
9. In a room filled with smoke, where is there the least danger of suffocation?
10. Secure a sample insurance policy and study its provisions.

XXII

A Few Examples

City Fires

A GREAT many fires occur which are not described in the newspapers. A city editor may give space to only one of several fires which are reported to the newspaper office. In the smaller towns and villages the great majority of local fires are reported in the newspapers. If the reader is on the alert for accounts of waste and loss of life due to fires, he will be much impressed and even appalled at the daily record of destruction. The following four clip-

A TYPICAL FIRE SCENE

pings, merely typical of hundreds and even thousands appearing in the daily press, are from the first page of nearly consecutive issues of the Chicago *Herald*, 1915.

BELLE ISLE BRIDGE BURNS AND MAROONS THOUSANDS

Spectacular Detroit Blaze Does $250,000 Damage and Delays Crowds of Women and Children.

Detroit, April 27. — Belle Isle Bridge, connecting Belle Isle and Detroit, at East Grand Boulevard and Jefferson Avenue, three miles from the center of the city, was practically destroyed by fire today. Shortly after the outbreak of the fire the entire center of the bridge collapsed and fell into the river. The fire, which is said to have caught from a tar wagon, caused probably $250,000 loss.

Thousands of women and children spending the hot day in the island park were marooned.

John Downey, superintendent of police, came to the rescue. He organized a large fleet of boats of the most nondescript character and in a short time began to ferry the crowd homeward. The ferry Garland was hurried to the scene. Loaded with nearly 2,000 passengers, the Garland ran aground, but was released after giving the passengers a bad scare.

MANY AURORA RESIDENCES ARE IMPERILED BY FIRE

Women and Children Fight Flames When 26 Roofs Ignite From Brands of Burning Barns.

Aurora, Ill., April 28. — [Special.] — The roofs of twenty-six houses in the fashionable southeast residence section caught fire this afternoon from brands carried from burning barns by a stiff west wind.

The greater part of the east side residence district was imperiled, but men, women, and children volunteer fire fighters rushed out with buckets, garden hoses, and patent fire extinguishers and held the incipient fires in check while the fire department fought the flames in three barns, which were completely destroyed.

For a time it seemed that the fires would spread beyond control because of the shortage of water.

CIGARETTE DESTROYS TOWN

Bay City, Mich., April 29. — The village of Hillman, in Montmorency county, was almost totally destroyed by fire today. The blaze started in the town hall, presumably from a lighted cigarette stub. Incomplete reports said the property damage would reach $100,000.

INCENDIARY TRACES FOUND IN FOUR FIRES AT PEORIA

Flames Drive 175 Guests from Two Hotels and Cause Damage of $50,000.

Peoria, Ill., May 2. — [Special.] — Four separate fires, believed to be the work of an incendiary, which broke out in the same block in the heart of the wholesale business district early this morning caused a loss estimated at $50,000 and drove 175 guests from two hotels into the streets in their night garb.

A general alarm brought every piece of fire-fighting apparatus in the city to the Smith book bindery at Main and Washington streets. Within a short time flames broke out in the Greisser Produce Building, in the same block, and pierced a wall into the Glasford

Hotel. Policemen awakened seventy-five guests and sent them scurrying from the building.

The third fire broke out in the Straesser commission house, two doors distant, and the fourth fire in the Bell-Wittick Company Building and the Hunter & Strelow wholesale house.

Prairie Fires

The clipping below is from the Williston, North Dakota, *Herald*, April, 1915. Williston is a small city near the Canadian and Montana boundaries and is located in the shortgrass country, where grazing and dry farming prevail. The prairie fires swept over large areas of two counties.

Prairie Fire

Prairie fires have swept large areas in Williams and McKenzie counties within the last week, causing losses which aggregate thousands of dollar. No reliable estimate of the losses can be obtained. No lives have been reported lost and while a number of barns and outbuildings have gone up in smoke, and several residences have been burned, hard work has saved the majority of the buildings threatened.

Dangerous fires also burned near Trenton in the brush land Tuesday afternoon and evening and another fire burned over a considerable area south of the railroad tracks two miles west of the city. Fires have also been reported in several other sections of the county and in McKenzie county across the river.

Fatalities

It is not alone the great property loss which impresses the reader of accounts of fires, but the death record as well. Every case of injury or death by fire has its many tragic associations.

The record of deaths by fire in Illinois during the year 1914 is given in the summary below, which is reprinted from the Report of the State Fire Marshal. Read with imagination, this statement of fatalities, with causes, should inspire one to do all in his power to make such occurrences impossible in the future.

Starting fires with kerosene	39
Clothing ignited by stoves and grates	39
Clothing ignited by matches	34
Gasoline explosions	27
Clothing ignited by bonfires	27
Burned in burning buildings	26

Clothing ignited in manner unknown	24
Gas explosions	13
Clothing ignited by kerosene lamps	12
Electrocuted or burned by live wires	9
Dynamite explosions	9
Firework display explosions	6
Stove polish explosions	5
Clothing ignited by sparks from pipes	4
Struck by lightning	4
Clothing ignited by lighted candles	3
Fireworks set clothes on fire	2
Moving picture film explosions	2
Clothing ignited from Christmas trees	2

For the Recitation

1. Collect newspaper reports of fires occurring during one week in a given territory.

2. The class may prepare a file of fire prevention clippings covering different phases of the subject.

3. How are fire losses reported? Talk with insurance agents and men in the city fire department.

4. Comment upon any features of the above clippings from the Chicago Herald.

5. Look up Williston on the map. What other states have physical features similar to those of North Dakota?

6. In view of the facts quoted from the Illinois publication, prepare a set of cautions for the prevention of death by fire.

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